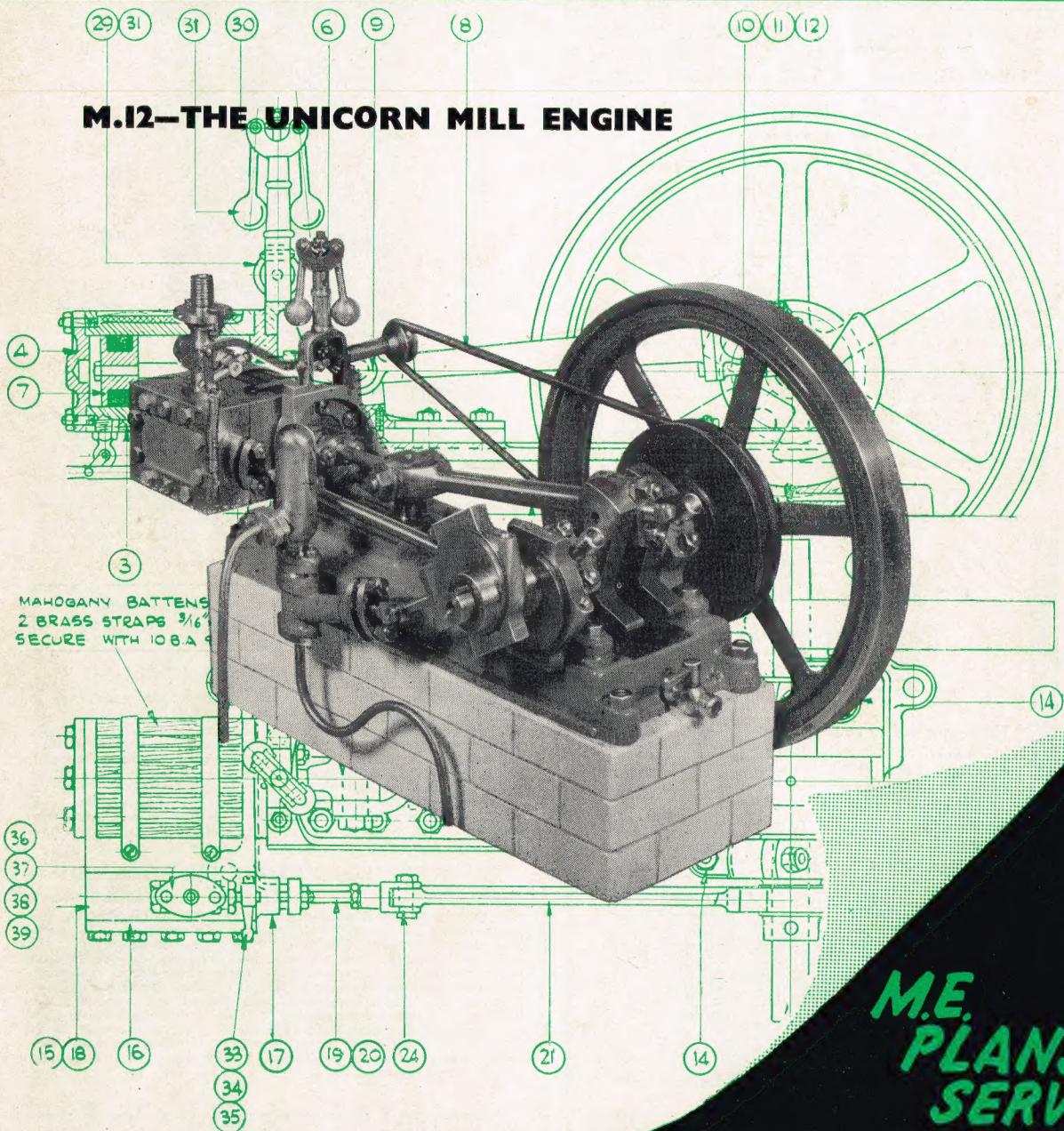


Model Engineer

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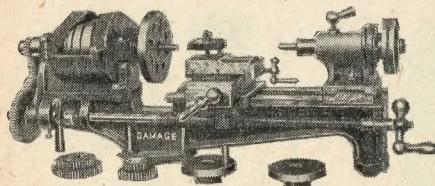
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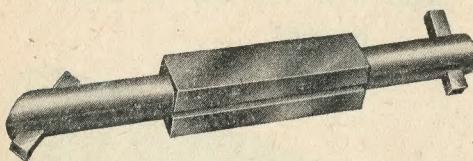
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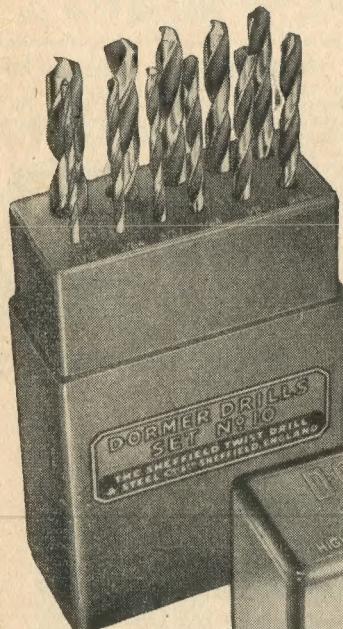
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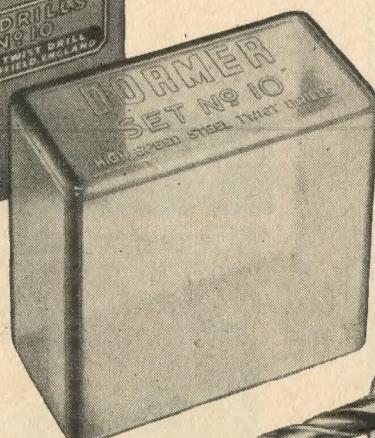


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28 MARCH 1957

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NEXT WEEK

Musical clock cutters: Details of cutters for making clock gearwheels

Reversing by radio: Simple reversing gears for i.c. engined model boats

Myrmidon—4: The afterdeck fittings and the erection of the masts of this 18th ship-rigged man o' war

St Ninian—7: Fitting the deckhouse

All correspondence should be addressed to the Editor, Model Engineer, 19-20, Noel Street, London, W.1.

Smoke Rings

A WEEKLY COMMENTARY BY VULCAN

MANY people will be disappointed that *Mayflower* will not be able to visit London and other ports before she sails for America. In a way it is not surprising that the time taken for her construction has been longer than was expected for no such ship has been built anywhere for centuries, and no living person has any experience of how long such a job would take.

From the nature of her design and construction much of the work had to be done by hand, and by rather primitive tools—tools which few people in the country have had any experience in using. The time available for testing the ship and getting used to handling her will be cut to a minimum, and from many points of view there will be few people as disappointed as her builders, Messrs Upham, and her master, Alan Villiers, at not having more time to try her out.

However, most elaborate arrangements for her reception have been made in America and it is important that she reaches Cape Cod by May 25. All the shiplovers of Britain will wish *Mayflower* a safe and successful crossing.

Nuclear propulsion

IT is encouraging to know that the application of nuclear power to ship propulsion is being undertaken

both by the Admiralty and by British shipbuilders. In fact the designs for a nuclear-powered submarine are already well advanced at the Barrow-in-Furness yard of Vickers Armstrongs. Naval officers are being trained at Harwell so that they will be prepared when the ship is ready to be taken over.

The new submarine is to be named *Dreadnought*. The opinion has been expressed that such an old and honoured name, which has usually been borne by First Rate Ships-of-the-Line, should not be given to a submarine. The last ship to use the name was the famous *Dreadnought* of 1906, a ship which opened up a new era in battleship design.

Future of carriers?

The new *Dreadnought* might well inaugurate a new era in warship design, and who can tell whether the submarine may not be the most effective fighting ship should we ever engage in another naval war? At one time it was thought that the aircraft carrier was the capital ship of the future, but with guided missiles this is now problematical.

With the merchant ship, conditions are very different, with cost the primary consideration and cargo carrying capacity a close second.

Here again the possibilities are being explored. Russia is said to have an atomic ship on the stocks already—a prototype which is not expected

SMOKE RINGS . . .

to be economic—to be launched next November, and the United States has put in hand a nuclear propulsion plant of 20,000 h.p. with the idea of its installation in a passenger liner of 12,000 tons.

Other countries are working on atomic ship design, and now it has been revealed that Britain is planning a super-tanker of about 80,000 tons deadweight for atomic power. Her turbine, with the reactor protective screen of concrete or steel, will be located amidships, possibly because of the great concentration of weight in a relatively small space.

The propulsion unit is expected to last 16 years without replacement. Although the ship is expected to cost about 11 million pounds to build, it is hoped that the high initial cost will be offset by low running costs.

Era of the car

SCALE models and souvenirs of famous machines in the history of the motor car from the horseless carriage to the latest gas-turbine designs will be seen at an exhibition with which the R.A.C., the oldest motoring organisation in Great Britain, is commemorating its diamond jubilee.

"The Age of the Motor Car," at the Tea Centre in London's Regent Street, is open without charge from April 11 to May 4. Afterwards it leaves London for a year's tour of the country. Stretford in Lancashire, Coventry, Blackpool, Scarborough, Leicester, Bristol, Portsmouth and Brighton are among the places to be visited.

Any town should be proud to welcome this exhibition. It tells the

story of motoring mainly by means of paintings. There are also many photographs, together with models and historical relics, and the enthusiast for antique motorcycles will find much to interest him, including prizewinners from the A.C.U.'s motorcycle model competition of two years ago.

More than one way

HOW can one bore a hole through a standard lamp upright measuring 5 ft on a lathe which is a bare 24 in. between centres? J. Nixon tells in an article in this issue how he overcame this difficulty.

Problems of this nature—where the work is too big for the machine or the tools are inadequate for the job—are constantly cropping up in the home workshop and it is to the credit of model engineers that they almost invariably solve these riddles.

I am sure all of you have grappled with such problems in the course of your favourite hobby and the methods by which you have solved them must be extremely varied and ingenious.

I find these personal anecdotes very interesting. Why not write and tell me about them, enclosing sketches or photographs? Those suitable for publication will be paid for.

"City of Truro"

FROM a passing train the old G.W.R. locomotive *City of Truro* was seen on Monday, March 11. My informant tells me the engine was standing outside the erecting shop at Swindon, glinting in glorious sunshine and "looking perfectly lovely."

This resuscitation of a famous old engine, removed specially from a museum, must be unique in that the engine has been officially taken back into stock for an indefinite period

Cover picture

The Unicorn engine and plans for its construction. This engine is a model of the reciprocating horizontal mill stationary engine in industrial use about 60 years ago. Hundreds of Unicorn models have been successfully built, and many have won awards for their constructors. Further details about the plans for this engine and of the Percival Marshall Plans Service appear on page 458.

for the prime purpose of working certain excursions and special trains.

I know that the old Great Northern 8 ft single was removed from the Railway Museum at York in 1938 and ran a few very special trips; but she was not officially returned to stock for the purpose but was simply "on loan" to the L.N.E.R. running dept. *City of Truro* is, at least temporarily, in stock and for that reason she could be used to work any train if the need were to arise.

First schedule

It would seem that she will be moved from one motive depot to another according to the station from which she will be required to run trains; at present her home station is likely to be Wolverhampton, since her first trip is scheduled, subjected to satisfactory steam trials, to run the Festiniog Railway Society's special train on March 30 between Wolverhampton and Ruabon, departing from the former place at 10.22 a.m.

Particulars of the return trip are not available at the time of writing.

Calling New Zealand

A MODEL engineer who is emigrating to New Zealand tells me that he is finding difficulty in getting information about some of the specific problems facing him.

In particular he would like to know what mains voltages operate in the two islands and what rules and regulations are enforced by local authorities concerning private workshops.

Moreover, he wants details of what model engineering requisites are readily available in the shops, for, as he puts it, "I don't want to take a lot of odds and ends with me if I can get small tools easily when I am there." He intends to take his lathe, drill and grinder with him.

If any reader in New Zealand can supply information I will be very happy to pass it on.



A MODEL WHALE CATCHER

*This model built by
R. C. JACKSON presents
opportunities for fine detail*



IT WAS after reading Mr Chapman's articles on the construction of metal-plated hulls that I decided to make a more ambitious model including a double-acting twin-cylinder steam engine with self-replenishing boiler feed and force pump lubrication. The self-starting advantages of this type of engine had been demonstrated by other builders at the pondsides.

This was to be my third ship model, the others being made of timber on the bread and butter principle. The advantages of a metal hull are quickly realised—no more blistered paint on the interior from a misdirected blow-lamp. And no worries about broken paintwork on the outside; very dangerous to wooden boats.

Some years ago a scenic model of the catcher *Southern Wheeler* by Mr Shelton, of Dunstable, was shown at an M.E. Exhibition. I was immediately attracted to the lines of this rather unusual vessel.

These small ships are designed for their specialist occupation which includes sailing from Norway or Scotland right through the tropics of the Atlantic for their work in Antarctic waters, where of course they have to encounter ice conditions.

This particular model is one of the *Setter* class, of which there are many marks, some steam and more recently motor ships, built for the Hector Whaling Co. of London and Oslo by A. and J. Inglis, Glasgow. They are comparatively small ships, the dimensions of the original *Setter II* being approximately 190 ft x 30 ft.

As will be seen the hulls, of a rather curvaceous shape, have a very pronounced sheer, this bringing the gun platform high above the sea and helping to keep it dry. The hull is cut away at stem and stern to allow extreme manoeuvrability. It is said that this type of ship can "turn on a sixpence," an essential operation when stalking the whale.

HULL CONSTRUCTION

The drawings obtainable commercially were smaller than the 10 in. beam required for the power plant in mind, so the hull lines were enlarged from $\frac{1}{4}$ in. scale to $\frac{1}{16}$ in. and this produced a model 56 in. long.

The Chapman method of metal hull construction used here calls first for a wooden jig or mould to the lines of the model. This I made in the same way as a bread-and-butter hull, but it was not glued together but fastened with countersink screws as it had to be dismantled and withdrawn from the finished model.

It took about a month of spare time to complete the jig, and the next step was to mark out on the jig approximate position of the plating. The plates were cut from 14 thou. brass sheet and soldered in position, starting at the keel and working with the jig upside down.

One of the advantages of this method is that it needs no internal braces or ribs, apart from deck beams which can be soldered into position after the timber mould is removed. An angle beam or deck ledge cut from the same brass material was soldered around at deck level and the deck fitted and soldered on to this.

POWER PLANT

As I had had no previous experience in the construction of engines and boilers it was with some trepidation that my savings were ploughed into and a small lathe purchased. Castings



*Top: SETTER II
in "dry dock"*

Left: Hove to

A model whale catcher . . .

and drawings of the Warrior double-acting twin-cylinder steam-engine were obtained and after taking some good advice from other club members a start was made on the engine.

Some snags were encountered and some mistakes were made, including the scrapping of an almost completed crankshaft, but ultimately a shining engine emerged which turned over nicely when connected to a bicycle pump.

The internal flue boiler made for this model was designed by Mr Westbury (who is also the designer of the Warrior engine) to power a large model paddle engine. It was such an efficient boiler that it seemed just the thing for this model, even if it might prove to be a bit heavy.

The power plant was fitted into the finished hull in the early months of 1955 and a test run made on the club waters at Wood Green. Although the gear ratio of the pump drive had to be reduced, the power of the engine was more than satisfactory.

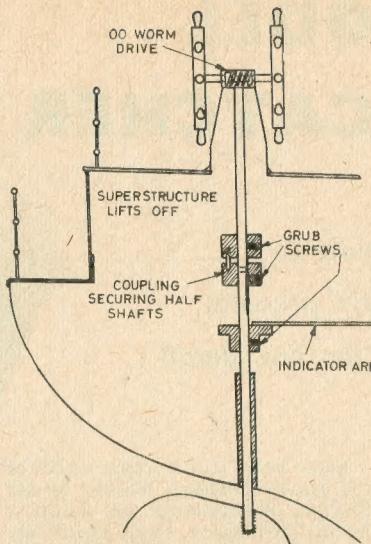
SUPERSTRUCTURE & FITTINGS

One of the advantages of building this type of model is that the superstructure is constructed in one piece and located on the deck combing and can be lifted off the model in one piece enabling the power plant to be easily maintained.

Brass was again used for the above deck work, this time 10 thou. thick. It may be a little more expensive than tinplate, but it is immune to attacks from rust which could attack the hull in some inaccessible place unnoticed by the owner.



Left: Broadside view of SETTER II "at sea"



Details of the steering gear and the coupling

As will be seen, there are numerous stanchions on the model, some two-and others three-ball. These were made by bending $\frac{1}{16}$ in. half-round brass into split pins then adding the extra balls by inserting gramophone needles into a piece of timber at the position of the rails and squeezing the half-round brass around them with small pliers.

The legs of the split pins were then soldered together and cut to length, the ends threaded 9 B.A. and screwed into position in the hull, the railings threaded through and the stanchions pulled into an upright position and given a touch of solder.

The finished railings are just a bit larger than scale but are quite robust, and the model may be held safely

by them at the stern with the engine opened full out.

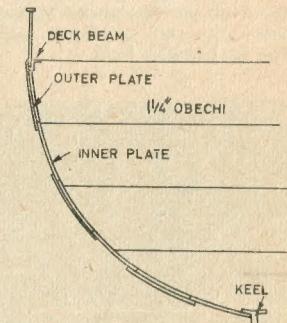
Readers may be interested in the method of erecting the masts. They were fitted into brass tubes soldered into the decks, forming the lower part of the masts. Into these tubes were dropped springs which, when the rigging cables (made from control line wire) are hooked down, keep the cables and the whaling ropes taut.

GUN AND WINCH

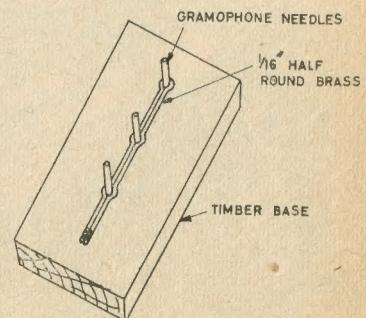
In making the whalegun (carved and turned from beech) great assistance was given by Mr Gay of the Hammersmith Ship Model Society, who has constructed and exhibited a working model $\frac{1}{2}$ in. scale gun; the gun on this model is non-working. The harpoon has been allowed to go a little rusty which seems to add to the realistic appearance.

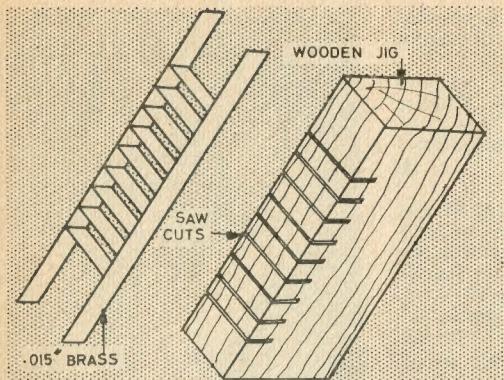
The modern whaling winch is a most complicated piece of machinery. The whale catcher recently added to the exhibits in the Science Museum at South Kensington was studied at great length, for although the gun on this model is not very accurate, being just a plain piece of turned brass, the winch is quite a faithful replica of the original—even if parts are of polished brass! Sketches were made of this winch while curious schoolboys tried to ascertain what was going on.

The 12 gears for the model winch were turned from dural; at this scale



Right: Section of hull jig and plating; method of making the stanchions





Left: The soldered steps and the wooden jig for making them

Right: Deck and fittings removed showing the power plant

the lack of teeth on them doesn't seem to show, particularly when the whole is given a coat of matt black paint. However, knurling them would have been quite satisfactory.

The method used for the construction of the steps, of which there are no fewer than seven sets, was to first plane a small piece of timber to the width of the treads and then to mark out the position of the treads on this and made sawcuts on these marks with a junior hacksaw to take the treads themselves (made of 15 thou. brass).

The side members made of the same material were then tinned both sides (the treads on the ends) and the whole was assembled and held in position with drawing pins while the soldering iron was run over the sides, sweating the whole together. The work was then removed carefully from the jig, cleaned up and cut to length.

PAINTING AND FINISH

It has always been my opinion that more working models are spoilt by gleaming paintwork than any other thing. After all, the first thing one is struck with on seeing a ship at close range is the dirtiness of it. Although not being a sufficient purist to apply authentic dirt to the model,

WIN A MYFORD SUPER SEVEN LATHE

Just a reminder. The closing date for the competition in which you can win a Myford Super Seven lathe is now a little over a week away—Friday, April 5. A coupon and details of entry are on page 481.

anything that gleams on a model is almost always out of place.

To find a paint that has an eggshell finish and is at the same time waterproof (essential on a timber hull) took a little research; finally it was found that by mixing different quantities of Robbialac undercoat and synthetic finish the correct colour and amount of shine (or lack of it) could be obtained.

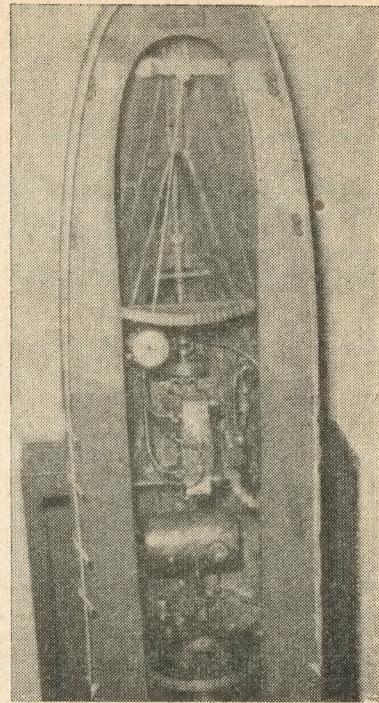
Some sections of the deck on the prototype are boarded with timber; this was depicted on the model by fixing similar sections of 1/32 in. resin-bonded ply to the deck with a new waterproof and oilproof adhesive, after first marking the deckboards with a sharp pencil and giving one coat of varnish so as not to make it shine.

A word should be said about the method of adapting the emergency steering-wheel to work the rudder on the model. The emergency gear on the drawing needed only to be moved about $\frac{1}{2}$ in. to bring it directly over the rudder. All that was required then was to fit a OO electric railway worm-drive into the top of the steering column. When the superstructure was lifted off, the drive was broken so a coupling had to be fitted at this point.

An indicator arm taken off the shaft tells the position of the rudder. This arm is at least 9 in. long and it enables very accurate and precise adjustments to be made as every degree the rudder is moved shows about 5 deg. on the indicator.

On final test the finished model gave quite a surprising display of speed and power. The safety-valve was at first set to blow at 75 p.s.i., but at this pressure the model moved much faster than scale speed.

With the spring in the safety-valve taken out and compressed between the fingers a few times the boiler then did not rise above 50 p.s.i. and this pressure suited the model much better, although even now with the bypass on she will ship water over the stern when under way.

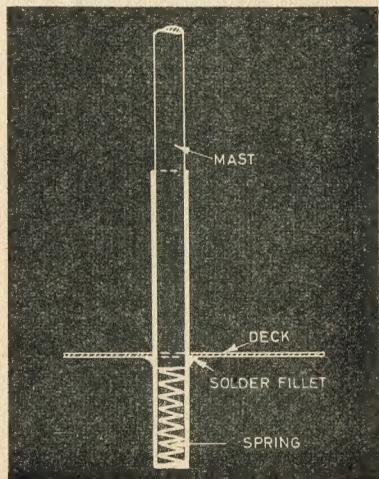


No ballast was needed apart from two pieces of mild steel put one side of the boiler to counteract the weight of the oil pump.

Access to the model under ordinary pondsides conditions is by lifting off the section of the deck directly behind the funnel. This section includes the lifeboats and other gear so that the primus-type lamp may be put in and out without doing any damage.

The layout of the power plant is: boiler amidships, lamp and pumps

Section of mast and socket



A model whale catcher . . .

astern of this with the pumps, bilge and boiler feed (functioning one on each side of the boiler and lamp) being driven on a common shaft athwartships from the engine which is

GEAR CUTTERS for the M.E. Clock

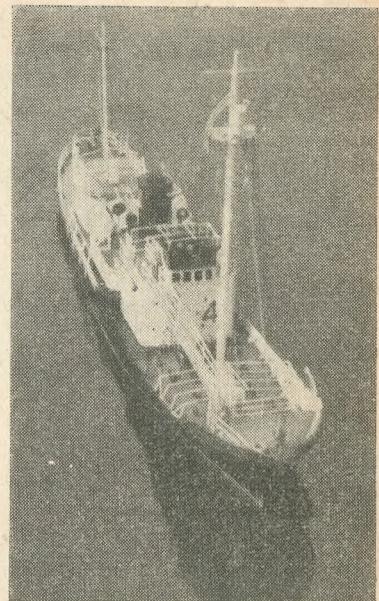
Several readers have sent in queries concerning the cutting of teeth for the gearwheels of the M.E. Musical Clock. Next week there will be an article dealing with this particular problem of clock construction

as far towards the stern as is possible. Also there is a cylinder lubricator pump working at 300:1 ratio.

In all, the model has occupied 2½ years' spare time, not including holidays and two trips to New York, as kitchen porter on the *Queen Mary* — but that's another story. □

Constructional plans for the Warrior twin-cylinder double-acting steam-engine (catalogue No M.10), price 2s. 9d., and working drawings for the internal flue boiler (catalogue M.7), price 5s. 6d., mentioned in the above article, are available from the Percival Marshall Plans Service, 19-20, Noel Street, London, W.1. Postage on each is 3d.

Right: Albatross'-eye view of SETTER II under way



BRITISH RAILWAYS EXHIBITION

Staff modellers produce some excellent work in a wide variety of subjects

COMPARATIVELY FEW locomotive modellers work in wood; comparatively few modellers in wood ever choose a locomotive. E. Inglesant's hand-carved *Springbok*, first-prize winner at the arts and crafts exhibition held in London by the British Railways Staff Association, was therefore not a type of model often seen. It had the further merit of being an impressive piece of craftsmanship.

Mr Inglesant, who lives at West Hartlepool and is a driver on North Eastern Region, had fashioned his 1,640 parts with a loving care for every detail. The boiler was complete with tubes, the cab bore its familiar equipment, and a group of minute tools added a final charming touch to the whole.

Other exhibits in the same class included a 2½ in. gauge Jubilee locomotive and tender by W. J. Hood of Swindon; three U.S.A. freight cars by W. S. R. Symes of Bournemouth; a parcel van by D. G. Robinson of Stratford; a passenger brake-third and a four-wheeled van by J. Dibb of Skipton; and a crane by A. G.

McWhirter of Eskbank and the Scottish Region.

In the ship model class, where M. Thomas of Neyland, a crane driver on Western Region, won first prize with a radio-controlled cabin cruiser, one more entry was listed than in the class for locomotives and rolling stock.

A. E. Burgess of Stratford exhibited a rowing boat electrically propelled by oars; G. Hollingsworth of Scunthorpe the steam trawler *Lahoma*; M. Rawlinson of Euston an electric tugboat; and D. Mack of Brighton a motorised launch. There were two galleons: H.M.S. *Victory* by B. G. Dawes of Rotherhithe Road, London (how many of us think of Nelson's *Victory* as a galleon?) and *Royal Prince* by I. L. Dunton of Whimple.

The class for miscellaneous models was especially interesting. F. E. Wilson, a clerk at Liverpool Street, well deserved his first prize. He entered two models, an L.C.C. trailer tramcar with four wheels and a tramcar bogie of the Guernsey Railway Company. Another Liverpool Street modeller, W. E. Harrison, had chosen exactly the kind of subject that the

public expects of a railwayman; his working layout showed a neat use of scenery.

Add the 1.5 c.c. compression ignition engine by J. T. Beaton of Stamford East, three 1914-18 aircraft by W. S. R. Symes, the tableau of figures by J. Evans of Euston, and the covered wagon and horses by K. C. Smith of Swindon (and the Wild West Region?) and it will be seen that this class had a pleasingly wide variety.

On the whole, the railway staffs evidently prefer painting and photography, and even then they use the railway not as a favourite subject but as the means of reaching the places, such as St Ives and Polperro, where every view is an invitation to canvas or camera.

The show was admirably supported by what used to be known as the gentler sex, and Lady Wilson, wife of Sir Reginald Wilson, chairman of the Eastern Area Board, found a fascinating display of needlework awaiting her when she arrived to present the prizes on the last day of this delightful event at Brunswick House. □

FEEDS—in lathe milling

IN SETTING UP work for milling in the lathe, an important influence is the manner in which the feed will be applied. The lathe spindle runs in the normal direction when driving a milling cutter—that is, the top of the cutter rotates towards the operator; or looking from the headstock towards the tailstock, the cutter runs in a clockwise direction.

Drills and end-mills rotate in this manner; and although a saw or slotting cutter could be reversed it would mean running the lathe spindle the opposite way, with the possibility of the chuck or driving plate unscrewing.

With the work mounted on the vertical slide, feed can be applied either from the cross-slide or from the vertical slide with the longitudinal feed of the saddle on the bed employed for putting on cut or locating the work in relation to the cutter, though this arrangement may be modified according to circumstances.

Having regard to cutter rotation, and the way in which feed may be applied, the next point is the manner in which the cutter will contact the work. In ordinary milling, the feed forces the work on to the cutter, as at *A*, and the thrust of feed and cutter is always in opposition.

This means that if the cross-slide feed is used the work should be mounted above the cutter and a start made near the operator for the work to be traversed away from him. To maintain the same conditions with cross-slide feed the work could be mounted to run under the cutter and brought from the far side towards the operator. But in many instances the cross-slide feed is too limited for this.

On occasion, from some convenience there may be in setting up or because the hazards are overlooked, the conditions of operation may be reversed and the down-cut milling principle introduced, as at *B*, with the possibility of breaking the cutter or spoiling the work from chatter or digging-in.

This is because, as the cutter rotates, the tooth which is nearing the end of its cut has a tendency to carry the

work with it, taking up the slack away from the feedscrew. When this happens the next tooth to strike the work has a greatly augmented cut to contend with, and in a bad case the tooth may be chipped or the cutter broken in halves; while there is always the danger of the work being moved or the finish spoilt.

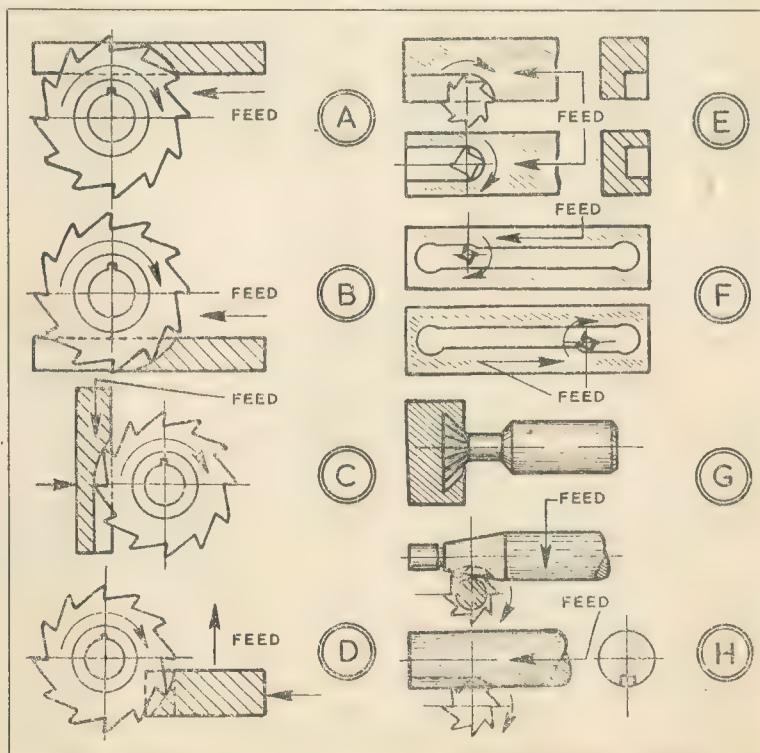
Even with the slide gibs tightened so that the feed is stiff the risk remains. Consequently, whenever possible the down-cut principle, as at *B*, should be avoided in milling in the lathe.

Using vertical-slide feed in a downwards direction, conditions are satisfactory when the work is on the far side of the lathe away from the operator, as at *C*. With the work mounted near to the operator the feed should be upwards, as at *D*, as when slotting a piece of material to make a fork. A slight tendency to

dig in may be noticed on commencing a cut if this is to be very deep. The remedy is to take a series of light cuts.

The principles apply in end milling when the cut is on the side of a bar, as at *E* (top), and in machining a slot or channel (bottom), the cut is balanced. Where a slot is to be widened the method at *F* should be adopted. Cutting on the top of the slot, cross-slide feed should be away from the operator; cutting on the bottom, it should be towards him. The same applies when milling a dovetail, as at *G*, where feed conditions should be as at *F*.

A keyway for a Woodruff or "half-round" key is machined as at *H* (top) with a direct feed on to the cutter; usually downwards from the vertical slide. A long keyway bottom can be cut with cross-slide feed under conditions similar to *A*. □



Steps to efficient running

OVER THE PERIOD of nine years of hauling passengers at Ridgeway Park, Chingford, involving a total distance of 1,000 miles, it is a natural development to seek to discover ideas that facilitate running, cleaning and other routine tasks.

Some of these have proved their worth and are described here. They can be applied in principle to almost any small locomotive employed on similar duties. *Likeada* and *Hybrid* have now passed on to new owners but I still have sufficient notes to convey descriptions of these worthwhile devices.

BLOWER

This is a device whereby, under normal running, control of the blower is connected to the regulator and saves much knob adjustment when, say, drawing into the platform, coasting, or stopping in emergency. This is shown in Fig. 1.

A stainless-steel spring-loaded plunger, C, is operated by a cam, B, on the regulator spindle. This plunger has a cannelure about 0.08 in. wide

H. J. TURPIN gives details of several devices and methods he has adopted to secure improved performance and ease maintenance work on engines

and slides in a gunmetal bracket screwed on to the hollow stay and receives steam from the main blower valve, D, which can be set for any desired maximum draught.

For convenience in assembly, sleeve, A, and the regulator handle engage two flats on the spindle and are retained by a 4 B.A. cap nut. The cam when adjusted is clamped by a nut on the sleeve, the correct adjustment being such that the blower valve begins to pass steam via the cannelure just before the regulator is about to close.

Another point on the subject of blowers concerns the fouling of the three No 72 holes in the ring blower of *Likeada*. As first made, the top surface of the blower received a heavy deposit of ash from the tubes such that one or more of the holes would not pass steam after about three hours' running. To overcome this trouble a spring clip or shield shown in Fig. 2 was fitted whereby six hours' running was obtained without fouling up.

Another thing, to find a No 72 hole with a pricker in the darkness of the smokebox was another difficulty. This

was overcome by turning a groove around the top face so that the pricker could be guided from one blower hole into the next with sense of feel only.

A radical departure in blower design was made on *Hybrid*. The single jet was fitted to the bottom of the petticoat pipe, as in Fig. 3. This position was completely out of reach of the ash, had very little surface area on top and never once became blocked over 600 miles of running. But being in such a position in relation to the top of the chimney it was necessary to fit a choke in order to effect a satisfactory draught. The nozzle was made from hexagon bar and assembled with a $\frac{3}{16}$ in. box spanner.

BIG-END ROLLER BEARING

It is not possible to say that roller-bearings on big-ends are more efficient than plain ones. It would be difficult to determine anyway; but one thing is certain—wear on the bearing as a whole is imperceptible after three million revolutions of the driving-wheels under load. The rollers have not seen the light of day in five years of running.

For sticklers for scale this bearing may seem bulky, but on *Hybrid*, on which nothing is to scale anyway, it is a wonderful fitment. The bevels around the boss and on the two retaining washers considerably reduce the out of scale appearance. Fig. 4 shows the method of making the rollers; and don't forget to make a few more rollers than are required for the bearing.

Several points arise in the design of the bearing in Fig. 5 in which the

Fig. 1: Method of connecting the blower to the regulator

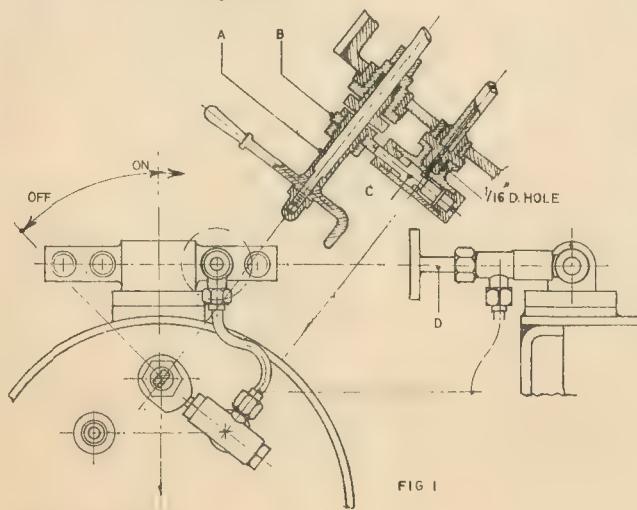


FIG. 1

Fig. 2: Spring clip which prevents fouling of blower ring

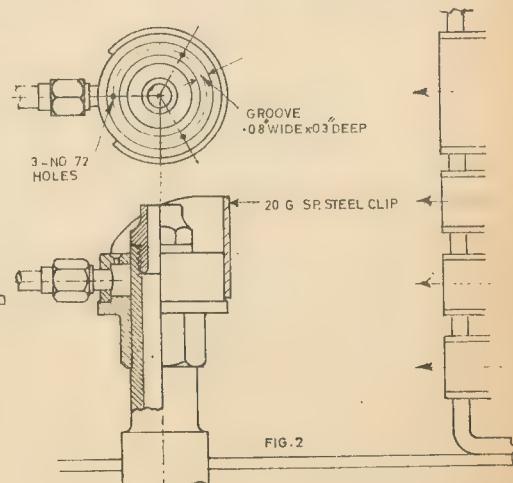


FIG. 2

crankpin is silver steel, hardened right out and tempered where shown hatched. The roller diameter is then lapped and polished.

Case-hardening steel is the material used for the connecting rod; it is cased locally in the hole and polished. For appearance' sake only a lubricator boss is raised at the top to carry a make-believe lubricating hole as it is unwise to break the surface of a bearing such as this.

CROSSHEAD PIN

One of the most annoying things on a small locomotive is to have to strip down the cylinders and valve gear in order to remove the connecting rod because the crosshead pin is assembled from the inside.

I saw to it that such a thing could not happen on *Hybrid* whose crosshead pin is assembled from the outside (Fig. 6) being registered by the diameter of the flange and spigot end of the pin.

This is a great convenience as the only two parts that are in the way of removal are the return crank and the guide-bar yoke, each of which can be removed by a $\frac{1}{8}$ in. hexagonal box spanner.

Two other points about this crosshead are that the union link lug is an integral part and the front end is screwed $\frac{5}{16}$ in. \times 40 t.p.i. to take the piston rod—a tight fit—itself fixed by a 3/32 in. cross pin.

PRESSURE-GAUGE CONNECTION

A device that has proved extremely useful on both engines is a pressure gauge attached to the bottom fitting of the gauge glass, shown at *A*, Fig. 7.

It obviates a connection to the boiler proper. Moreover a hole equal to the bore of the glass can be made

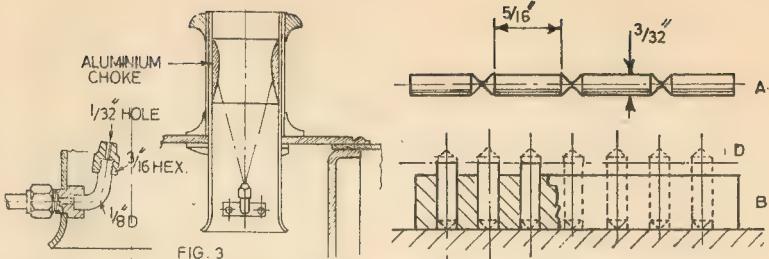


Fig. 3: The new type of blower that was fitted to the HYBRID

Fig. 4: Method of making roller-bearings for big-ends. The wear on the roller-bearings of *HYBRID* is still imperceptible though there have been three million revolutions of the locomotive's driving-wheels, says the author

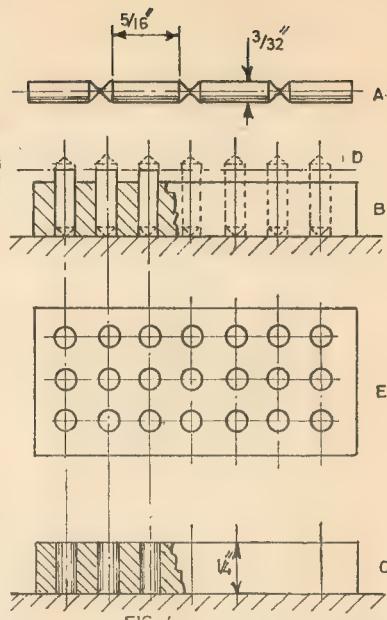
continuous through the length of the fitting so that by removal of the plug *C*, and union nut, *A*, the waterway can be positively cleaned. The steam blowdown fitting is in the usual place.

A further point in design is that with all fittings that demand a correct position when screwed up tightly I have found that a flange diameter equal to about $1\frac{1}{2}$ times the diameter of the thread enables the fitting to be removed and replaced correctly (see *B*). Small flanges allow fittings to overturn.

This change was introduced to enable a cleaning brush to be used in superheater tubes.

In such cases where, say, four superheaters are connected together by a cross tube, as at *A*, Fig. 8, it is near impossible when using a butt joint, to apply any means of easy cleaning after a run.

To enable free access of a flue-brush the connections to the cross tubes were made as at *C*, where a scallop is cut halfway through each tube to make a scarf joint. The end



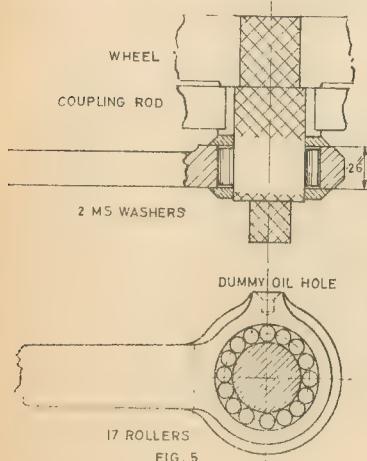
of each superheater tube is then plugged. The space now available for cleaning is shown at *B*.

TRAILING AXLE

Likeada's trailing axle, set well back towards the rear of the frame, was continually being fouled by grit spilled over from the ash pan.

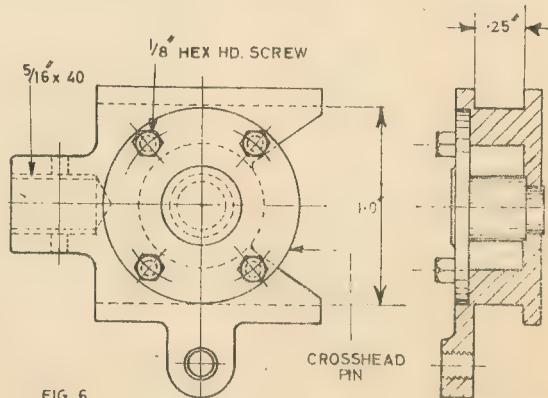
I tried a number of ways to avoid this and finally decided to connect the two axleboxes together by an inverted U-shaped plate which completely covered the axle. This proved satisfactory and the whole formed an axlebox unit and facilitated handling when stripping.

Based on the success of the foregoing and for appearance' sake a second design (Fig. 9) was produced but I did not get around to making it. It does keep the axle and bearings free from grit in any circumstances.



Left, Fig. 5: The crankpin is silver steel. The connecting rod is case-hardened locally

Right, Fig. 6: Design for a cross-head pin which can be assembled without dismantling the engine's cylinders



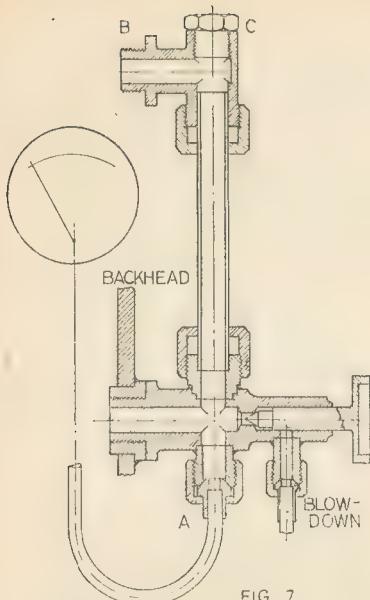


FIG. 7

Above, Fig. 7: Pressure-gauge fitting
Right, Figs 8 and 9: Connecting superheater tubes; and U-shape plate covering axle

Below, Figs 10 and 11: Method of overcoming valve-seating troubles; and special snifting valve

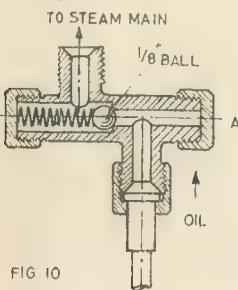


FIG. 10

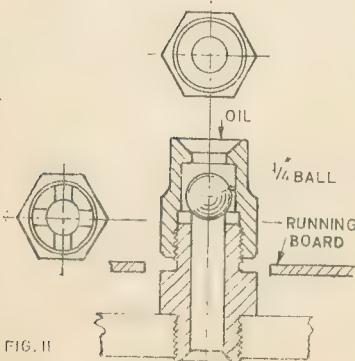


FIG. 11

The axleboxes have a spigot turned on the inside over which a piece of thin brass tube is lightly pressed to couple the two boxes together.

EASY-CLEAN OIL CHECK VALVE

Having once, because of oil delivery failure, had to dismantle the non-return valve in the oil supply on a busy track and failed to retrieve the $\frac{1}{8}$ in. dia. ball embedded in thick oil, it set me thinking seriously on how to prevent a recurrence.

Once the ball-valve, through failing to seat properly, lets steam back into the oil container then there is no other remedy than to strip down and clean the valve seat and ball. Fig. 10 shows how this trouble was overcome.

An extension to the valve body was made on the oil side of the valve and closed by the screwed cap, A, and in addition the valve itself was brought out to an accessible position on the left of the smokebox.

It will be seen that on removal of the cap a stiff wire poker (about 16-gauge) can be used to push the ball

In the early days of these engines I tried spring-loaded valves in the cylinder walls. These either did not open at all or constantly dribbled a spume of steam. The plug-cock pattern was tried but manual operation from the footplate while running was too involved and the cocks proved too fragile.

The answer came in steam operation through the medium of steam-valve, B, and a disc valve at the backhead, C, which takes steam from the boiler manifold. The handwheel, D, matches that on the blower (Fig. 1). The whole scheme is shown in Fig. 12.

There is one steam-valve, B, under the running board each side just in front of the cylinders and connections of $\frac{1}{2}$ in. copper pipe are made between two unions on the steam-valve and two banjo fittings, E, on each cylinder.

When the handle is turned clockwise steam passes straight into the hollow stay and into the steam cylinder, B, (0.5 in. dia.). This lowers the piston so that a cannelure on the valve ($\frac{1}{4}$ in. dia.) comes to rest opposite

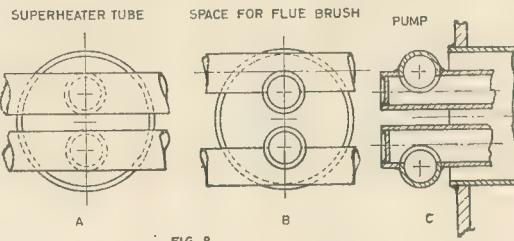


FIG. 8

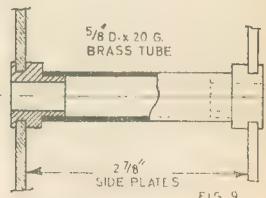


FIG. 9

from its seat momentarily while a rush of steam cleanses the oil-way.

A fouled ball-valve can thus be cured not only without removal of the relevant parts on the steam side but without even turning off the steam at the regulator !

EMERGENCY LUBRICATOR AND SNIFTING VALVE

Still on the subject of oil, Fig. 11 shows a special snifting valve whereby a squirt of oil may be injected into the steam-chest at any moment in emergency. It protrudes through the running board for easy access, and for removal of the ball if necessary, and it is fitted both to the piston valve on *Likeada* and the slide-valve on *Hybrid*.

It should be pointed out that the whole essence of such features as this is to maintain running for say six hours without having to leave the continuous track.

STEAM-OPERATED DRAINS

It is surprising how useful hollow stays can be. *Hybrid* has two; one is used for the blower and the other is used to operate the cylinder drains.

the union connections from the main cylinders, thus connecting them to the drain exit.

When the handle is turned 90 deg. anti-clockwise the disc is rotated so that boiler steam is cut off and the curved port covers both the steam cylinder hole and the hole leading to atmosphere.

By so doing spring, H, can raise the piston in B, eject the spent steam and cut off ports at section, F. The weight of the return spring, H, should be just sufficient to overcome friction when cold. A hole, J, in the protruding part of the piston is for manual operation when the locomotive is not in steam.

A point worth mentioning is that only one steam valve, B, for the two locomotive cylinders need be used if there is sufficient space for it and for the four connections, instead of two at section, F.

It must always be borne in mind, of course, that these $\frac{1}{2}$ in. dia. pipe connections should be kept as short as possible because the capacity of each one adds to the initial volume to be filled with steam at each end of the locomotive cylinders. However,

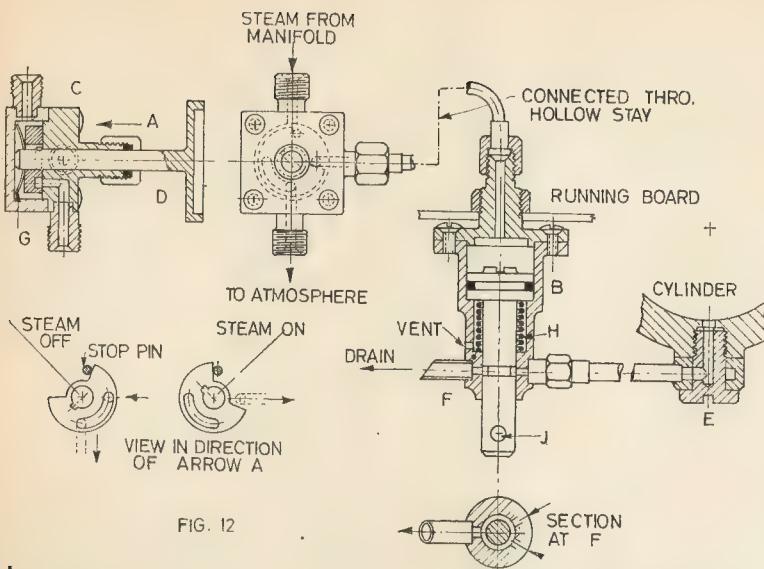
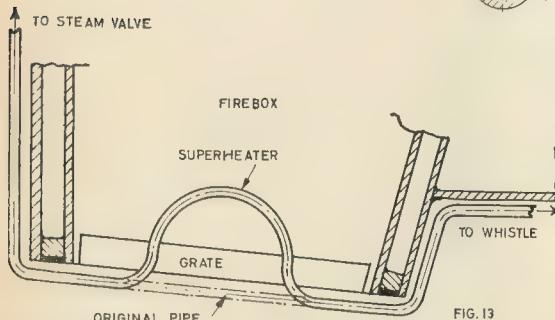


FIG. 12



it is very minute and makes no practical difference when running.

There are many ways of fabricating nameplates but the advantage of making them this way is that there are no minute letters to fashion and handle separately—and to try to keep square while sweating to the backing plate. These letters cannot get out of position.

Removal of the shaded areas is done with fine-tooth blade in an ordinary fretsaw frame. All the edges are then trimmed straight and smooth with a Swiss file $\frac{1}{16}$ in. thick and about $\frac{1}{4}$ in. wide. Fig. 14 shows sequence of operations.

And lastly, one of those ideas that failed completely—a whistle superheater (Fig. 13).

To overcome a gurgling whistle I took part of the whistle steam-pipe, in the form of a small loop, up into the firebox so that it laid snugly against the inside wall. On the track, when demand came to use the whistle, I pressed the valve but no sound came. I opened the fire-door and peeped in. Alas, no pipe!

It is a good thing to devise a set of pipe unions and make them in bulk before setting about any pipe-

Above, Fig. 12: Details for steam-operated drains

Left, Fig. 13: An idea that failed

Below, Fig. 15: Dimensions for the interchangeable unions

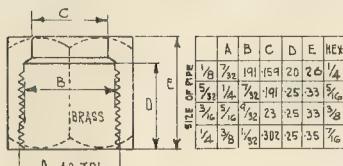
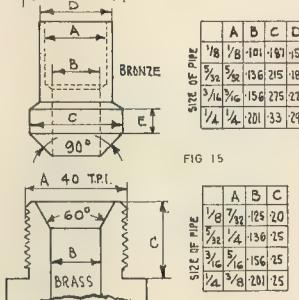
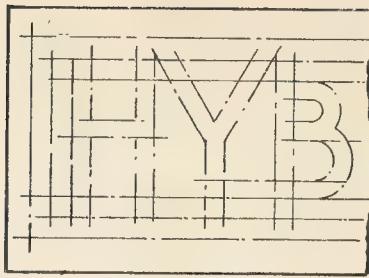


FIG. 15

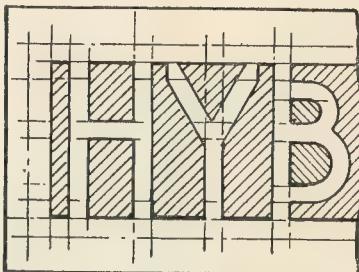


work on the locomotive. All my unions are interchangeable and made to dimensions in table Fig. 15. About two dozen sets of mixed sizes were made for each engine.

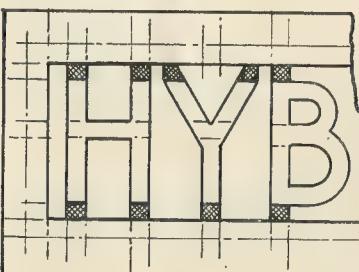
It will be noticed that the nipple cone angle is 90 deg. and the female member 60 deg. (made by Slocombe



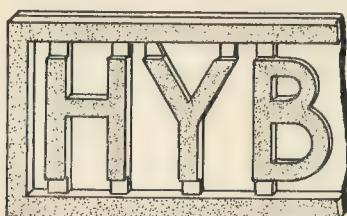
1



2



3



4

Fig. 14: Four stages in fabricating a nameplate. The shaded areas are removed with a fine-tooth blade held in a fretsaw frame. Final trimming is done with a $\frac{1}{16}$ in. thick Swiss file

bit). This produces a line contact—and never leaks. The odd looking decimals in the table are drill sizes.

Another point is that the nipples must be made of bronze to prevent the thin wall around the pipe melting when being silver soldered. \blacksquare

MANY of the popular designs which have been described in past issues of the MODEL ENGINEER are now available in the form of fully detailed prints, showing all items full size wherever possible within the space limitations of conveniently sized sheets. In view of the many inquiries received from readers for further information on these designs we propose to publish from time to time photographs of completed models which have been made from them, either in our own workshop or by readers.

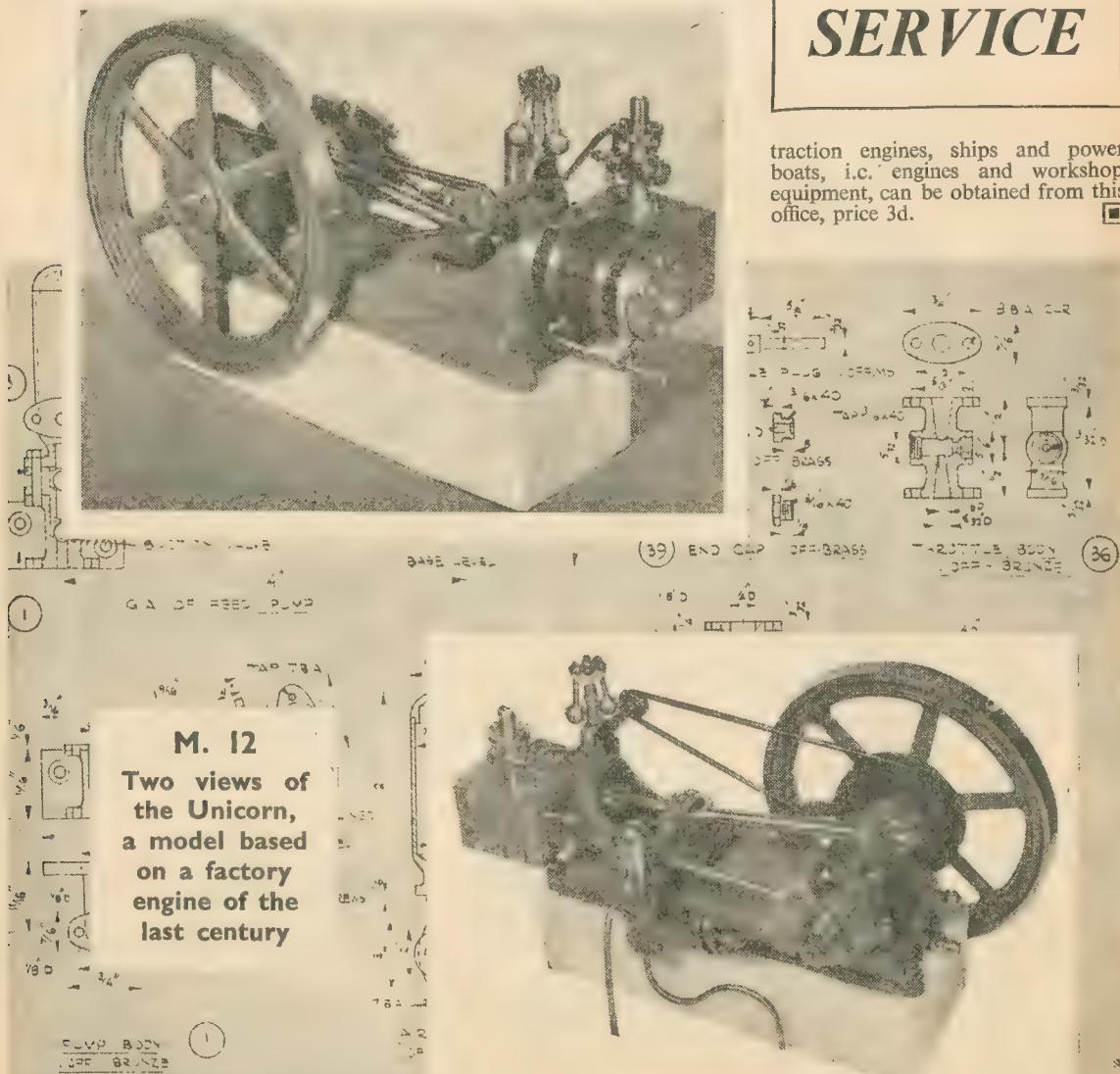
The example shown here is the *Unicorn* mill engine, a fairly typical reproduction of a throttle-governed

horizontal engine of about 10 to 12 h.p. as used for driving small factories and industrial plant some 50 or 60 years ago. The model is designed to a scale of 1 in. to 1 ft and is correct in general character, though constructional processes have been simplified to suit amateur workshop facilities.

This design is listed as M12 in our plans catalogue, and the price of the print is 3s. 6d. plus 3d. postage. Castings for construction can be obtained from W. H. Haselgrave, 1 Queensway, Petts Wood. Our plans catalogue, containing details of over 240 designs for model locomotives,

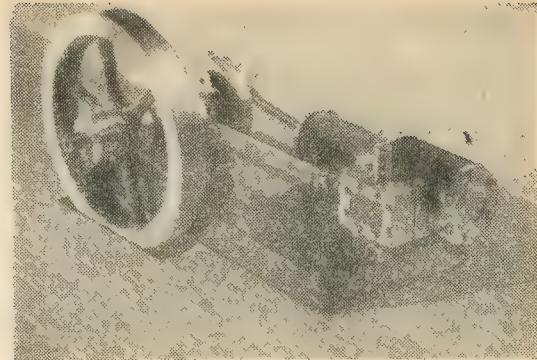
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THE PERSEUS HORIZONTAL STEAM ENGINE

By EDGAR T. WESTBURY



DURING the latter part of last year I described the construction of a simple horizontal steam engine, intended mainly as an exercise in elementary mechanical model work and to enable the inexperienced modeller to obtain a sound insight into the working principles of steam engines. This, for the purposes of classification, was given the title of *Theseus*.

The methods of construction adopted, in conformity with the wishes of many interested readers, eliminated (with one exception) the necessity for using castings, all parts being produced by fabrication from stock materials or machining from the solid. The exception was the flywheel; this could have been made in the same way; but a casting was used for convenience.

The choice in methods of construction is often indicated by sheer necessity—but more often by preference or the desire to economise in cost of materials or the amount of work involved. It is very commonly believed that the use of stock materials saves expense or simplifies work, or both, and it occurred to me that it might be a good idea to make a practical comparison of the two methods—fabrication versus castings—by building a second engine of the same general type and size, in which castings are used for all the essential structural parts.

This has now been done, with the results illustrated here, and, to distinguish it from the preceding example, the engine has been named *Perseus*.

As to the conclusions to be drawn from this comparison, I prefer not to be too dogmatic; undoubtedly circumstances under which material is obtained may vary considerably—also facilities for various operations—and these may sway the balance in

favour of one method or the other. I have found it both easier and cheaper to use castings, though this does not take into account the work or expense involved in producing patterns. As, however, the castings will be available in this case, this factor does not have to be taken into account, once the original engine has been constructed.

Certain alterations to the design have, of course, been introduced to suit the different constructional methods, and advantage has been taken to introduce minor refinements without adding complication. As most of the working parts are identical, both in shape and dimensions, with those of the *Theseus* engine, it is not necessary to illustrate or describe them all in detail... only to review the structural parts which have been altered in shape or call for different treatment in machining.

THE BEDPLATE

Instead of the plain flatplate employed in the *Theseus* engine, a deep box casting has been provided, which has greatly enhanced rigidity and more dignified appearance. The deep plinth, of wood or other material, which was necessary as a sub-base in the former case, is not now required and although for convenience a shallow plinth has been provided to raise the engine high enough to clear the flywheel, it would be more appropriate in a permanent installation of the engine to cut a clearance slot or "race" in the engine-room floor for this purpose.

Very little work is involved in machining or fitting on the base casting. The mounting locations for components are in the form of raised facings—all at the same level—and if no facilities for machining them are available they may be filed and scraped to bed evenly all over on a surface plate or a sheet of heavy

plate glass. It is necessary also to ensure true flatness of the rim on the underside, which may be obtained in the same way, but local accuracy and finish is not so important here.

If a large lathe is available the casting may be gripped over the ends and sides in the four-jaw chuck, and a facing cut taken right across, both top and underside in turn. This method cannot, however, be applied in a $3\frac{1}{2}$ in. lathe, and it is necessary to mount the casting on the faceplate. This may be found somewhat difficult, as it is not possible to apply clamps of the usual type. However, two bars of metal, about $\frac{1}{2}$ in. square in section, bolted to the faceplate close to the sides of the casting and each provided with about four screws to bear sideways against it, will hold it securely enough for this light operation. Exact centring, of course, is unimportant but the assembly should be in fairly good balance.

Another and perhaps simpler method of mounting the casting would be by drilling the fixing holes at the four corners and tapping them out to, say, 2 B.A. or $\frac{3}{16}$ in. so that screws with large washers can be inserted from the back of the faceplate. They should not be too long, as the faces of the bosses have to be machined off to the same level as the other four machined seatings. As the holes are clearance size for the fixing bolts tapping them will do no harm. To finish the base it is only necessary to fettle off any obvious roughness or irregularities which may affect appearance for it is intended that this and other structural parts should finally be painted.

MAIN BEARING PEDESTALS

The castings for the main bearing pedestals do not need machining over the faces and sides as in the previous engine, but in other respects similar machining methods may be used.

They may be held in the four-jaw chuck for boring and facing one side; care must be taken to locate them as squarely as possible both ways and also to avoid variation in height from the base. This is best ensured by not moving the jaw of the chuck in contact with the base when the first casting is removed, but leaving it in place as a locating point. The facing of the opposite side of each bearing is best done by using a pin mandrel, and the edge of the base flange may also be faced to the same level as the end of the bearing on each side.

To machine the base surface I recommend mounting both the castings together on an angle-plate, with a stud set in it at right angles, fitting the bore of the bearings. In this way it is possible to ensure that both pedestals are exactly the same centre height so that they line up horizontally.

CYLINDER SUPPORT

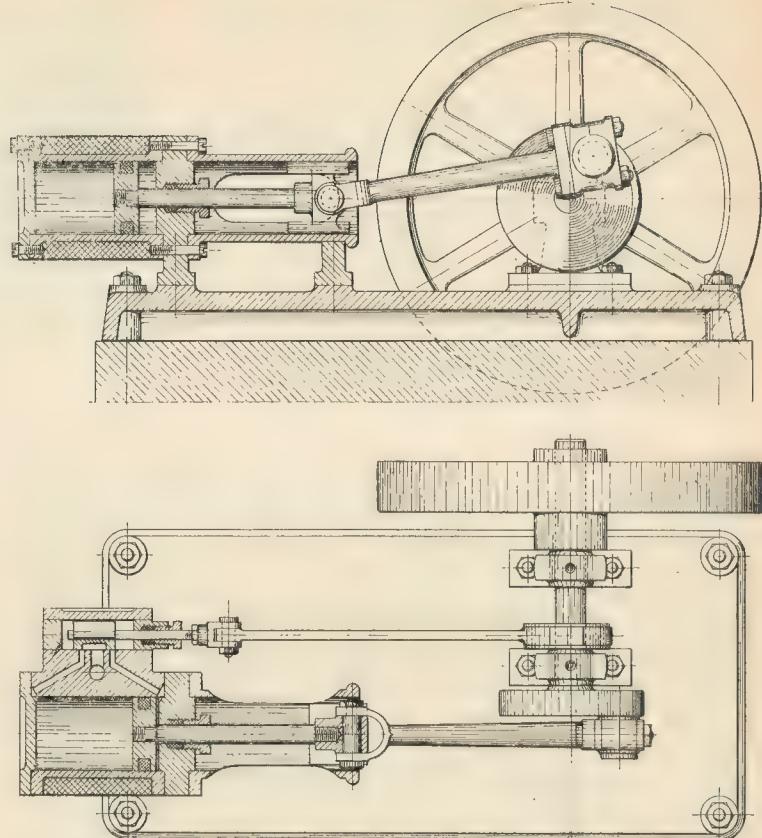
After machining the front and rear faces of the cylinder support in exactly the same way as described for the *Theseus* engine, with due precautions to ensure true concentric alignment of the register spigots and the gland, the casting is bolted to an angle-plate with a single 2 B.A. bolt through the bore to machine the base surface. This should be measured to ensure that the centre height coincides with that of the bearing pedestals.

The trunk guide must be chucked at the flange end, so that after boring it must be mounted on a true mandrel for facing the flange to ensure that it will line up truly with the cylinder axis when fitted. The outside of the casting does not need machining all over, but the flange should be faced to provide a true seating for the fixing screws, and the beading at the outer end should be skimmed up and polished. At the same time any obvious roughness on the outside may be either filed or skimmed for appearance' sake; the side apertures are provided in the casting, but their edges will need cleaning up with the removal of burrs where they break into the bore.

TRUNK SUPPORT

The base surface may be machined by holding this in the four-jaw chuck. For fitting the saddle piece many constructors will find it easier to file it as required instead of taking the trouble to set it up for either boring or flycutting; it does not call for specially high precision so long as the height from the base is correct to support the trunk truly horizontal.

As to the method of fixing it to the trunk some of the builders of the *Theseus* engine have found difficulty in locating and fitting the two 10 B.A.



screws at an angle in the saddle piece. My method of doing this is quite simple: drill the holes in the saddle piece and clamp the cylinder support, trunk guide and trunk support in their correct positions on a flat base. With a small bent scriber made from a knitting needle or a silver steel rod, mark the hole positions on the trunk from the underside of the saddle piece (marking blue on the trunk will help in getting a sharply defined mark), dismantle, drill and tap the holes. For inserting the screws the fixing holes in the base flange can be filed out slightly at an angle, enabling a thin watchmaker's screwdriver to be inserted.

If, however, it is considered too much trouble to put in two screws, a possible alternative is to put in a single screw of larger diameter, vertically in the centre of the support, with the head sunk to clear the base surface. In either case projection of the screws inside the trunk guide must be avoided and burrs round the holes carefully removed.

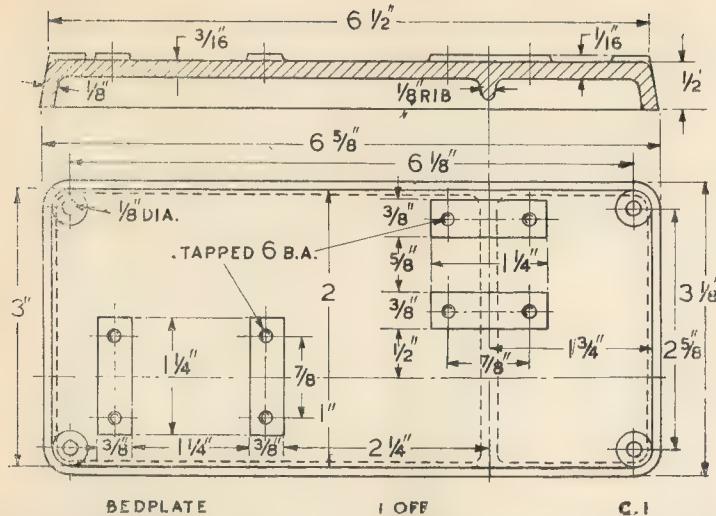
The crankshaft is built up in exactly the same way as that of the *Theseus* engine, the only difference being in the use of an iron casting for the

crank disc, which enables a balance weight to be incorporated—not, perhaps, of paramount importance in a slow-speed engine, but still a desirable refinement.

In the *Theseus* engine a flywheel casting which happened to be available was utilised; the only difference in this engine is that a smaller flywheel, more in proportion to the size of the other parts, has been fitted. The same flywheel could be used, of course, on both engines.

To simplify the connecting-rod construction a casting has been provided, but it could only conveniently be produced in gunmetal—which is rather unfortunate, as full-size engines invariably have steel or wrought-iron connecting-rods. The type of steel rod specified for the *Theseus* engine can, however, be machined from solid or fabricated as described. Alternatively, the glaring brassiness of the rod could be camouflaged by dull nickel plating—not buffed bright, please!

An iron casting is provided for the crosshead which very much simplifies machining, as it has a chucking piece which enables it to be held for all external operations. As the chucking



piece may be rough or inaccurate, however, it should be trued up by first chucking the casting over the shoes as truly as possible and taking a cut over it. Then by holding it in the three-jaw chuck the shoes may be turned and the edges and boss faced—also drilled and tapped—thus, ensuring exact concentricity in all essential respects. Cross-boring for the gudgeon-pin may be carried out in the same way as for *Theseus*.

CYLINDER AND STEAM CHEST

The ports may be cut by either side or end milling, according to individual preference—or even by the time-honoured millwright's technique of drilling rows of holes and chipping out with tiny chisels. For drilling the passages from the ends of the cylinders the important thing is to locate them at the correct angle.

Since designing this engine I have made some experiments with cylinder ports and have found that a single hole $7/64$ in. dia., or No 34 drill, will convey all the steam that the cylinder will take. For a given total cross-sectional area a single hole forms a more efficient passage than multiple smaller holes, as it reduces skin frictional losses. It is, however, a very different matter to use single round holes for control ports because rapid opening and accurate cut-off are essential to efficiency in this case.

The steam chest may have the steam inlet either at the top, or in the cover, as in the *Theseus* engine; in the former case, however, the sunk panel in the cover improves appearance and can be used to accommodate a nameplate or other insignia.

I found no difficulty in making all cylinder and steam-chest joints steam-tight without the use of packing. I

lapped the surfaces and smeared them with Wellseal jointing composition before assembly. However, thin paper or, better still, tracing cloth gaskets may be used.

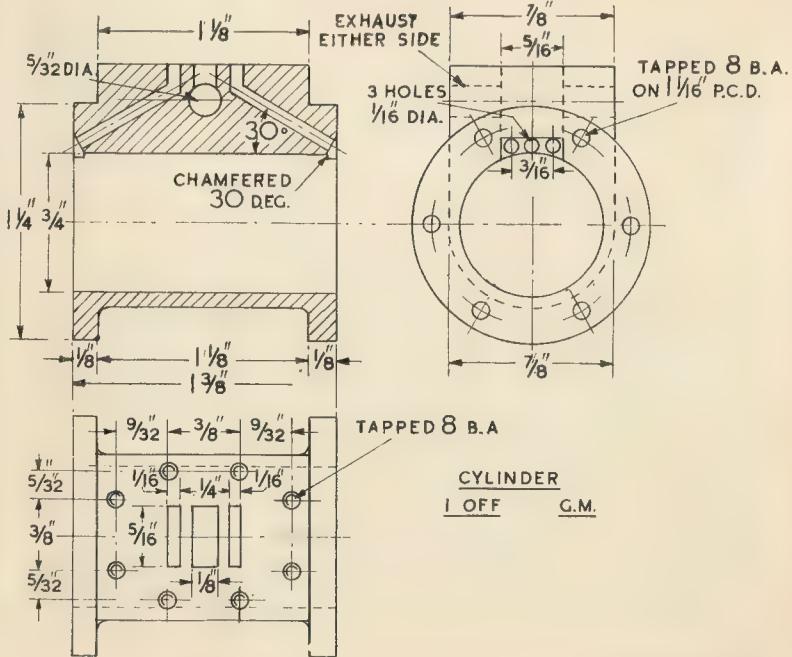
The assembly follows the same lines as the *Theseus* engine, but as the components must locate fairly on the bedplate facings there is not the same latitude for shifting them as required to compensate dimensional errors in the various components. A check on such important details as the length of the piston rod, however, is easily made on temporary assembly of the parts—and I think it is only common sense to do this. Either studs or bolts

can be used to attach the components to the bedplate.

In common with most other engine designs I have described, this engine offers plenty of scope for additional refinements to improve fidelity to full-size practice. Obviously, the replacement of slotted screws by studs and hexagonal nuts would help in this respect, though making no difference in practical performance. The number of studs in both the cylinder covers and the steam chest would also improve appearance—but beware running foul of steam passages!

Practical improvements include the fitting of cylinder drain cocks, wood or metal cleading and a control stop valve; it would also be possible to add a governor similar to that of the *Unicorn* engine. Some builders may wish to fit reversing gear, and there is plenty of room to fit double eccentrics for Stephenson link motion. But I would point out that few horizontal stationary engines, other than those for special purposes such as hauling or winding, needed to be reversible.

In common with the *Theseus* engine this design is eminently suited as a class exercise for schools and training establishments, as the individual operations on components are simple and straightforward, while introducing a wide variety of machining and fitting. Castings for the engine can be obtained from A. J. Reeves Ltd, Birmingham—and having used them in making the example illustrated I can vouch for their accuracy and quality. □



Tiny and Dickie

Two robust narrow-gauge locomotives which did some sterling work at Crewe

By Ernest F. Carter

DESIGNED by Locomotive Superintendent John Ramsbottom for use on the narrow-gauge inter-shop railway at Crewe Works, 2½ ton *Tiny* was, when she started work in May, 1862 (the same year that *Lady of the Lake* took the road), the smallest locomotive ever designed and built for a really practical purpose. That purpose was the hauling of 10- and 12-ton loads on the tortuous 18 in. gauge works track, with its 15 ft radius reversed curves, upon which pygmy locomotives originally designed for hauling barges on the Shropshire Canal had been used.

True to her name, *Tiny* measured only 7 ft 7 in. long overall by 2 ft 6 in. wide, her frames being of $\frac{1}{4}$ in. wrought iron plate each 7 in. deep, spaced 1 ft $1\frac{1}{2}$ in. apart and connected by buffer-beams, of which the front one

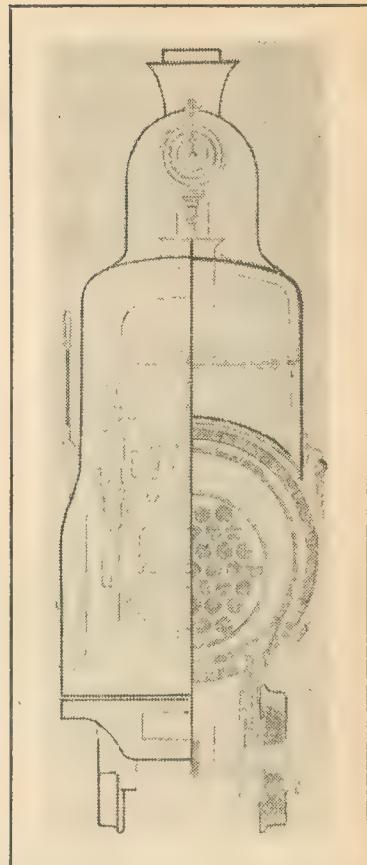
carried a 7 in. \times 3 in. wooden facing. The hornplates of the driving-wheel axle bearings were in one piece with the frames and the axlebox guides were formed by stiffening them (Fig. 2). The axles were carried in brass-lined bearings 2½ in. dia. \times 2 in. long.

The boiler, which was fed by a No 2 Giffard injector, was 2 ft in outside diameter \times 4 ft 6½ in. long between tubeplates and contained a flue 1 ft 5½ in. inside diameter \times 2 ft 5½ in. in length which was forged from one plate and flanged for attachment to the boiler endplate.

Firebars, 16 in. long, were fitted which abutted at their inner ends on a firebrick bridge of which the lower bricks were removable to permit ashes to be withdrawn easily from behind the bridge. From the front end of the firebox, which was thickened there to 5 in. to form the tubeplate, 37 \times 1½ in. tubes 2 ft long extended to the forward end of the boiler—

Above, Fig. 3: Half end rear elevation and half section of TINY

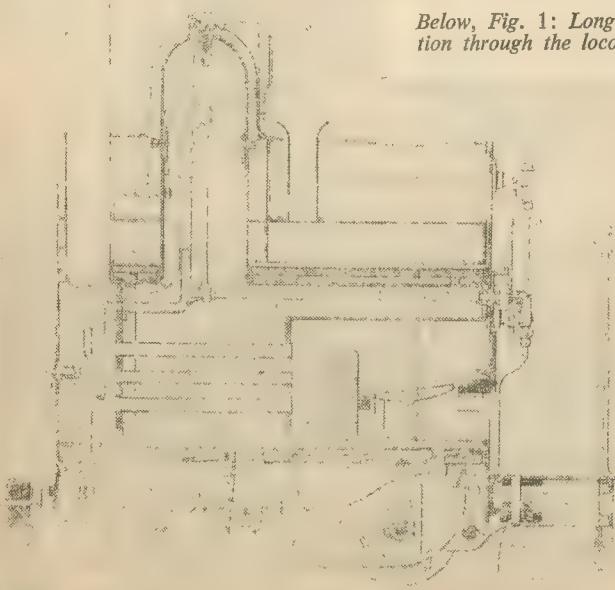
Below, Fig. 1: Longitudinal section through the locomotive TINY

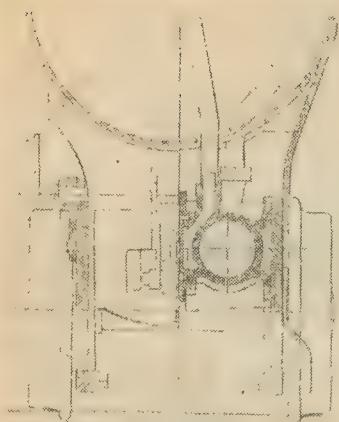


their internal surface being 30.27 sq. ft, which area, together with the firebox heating surface of 7.4 ft, gave a total heating surface of 37.67 sq. ft.

The boiler backplate was extended upwards for attachment to a 28 gallon saddle tank and coalbox, and downwards for connection to the main frames by angle irons. A 12 in. dia. dome 3 ft in height was surmounted by a pair of the well-known Ramsbottom patent safety valves and enclosed an ordinary brass steam-cock which served as a regulator. The pipe from the upper end of the water-gauge also led into the dome. The smokebox was only 8½ in. in length and the 6 in. internal diameter chimney extended aloft to 10 ft 0½ in. above rail level.

Tiny boasted two 4½ in. \times 6 in. inside cylinders, each of which were fitted with 3 in. \times $\frac{1}{4}$ in. and 3 in. \times 1 in. ports for steam and exhaust respectively, of which the brass slide-valves were driven by shifting-link valve gear. The wrought-iron pistons were forged solid with their rods, each of which was screwed into a crosshead which embraced a single overhead slidebar. Each connecting-rod was bushed only at the crank end, where





Left, Fig. 4: Cylinder and motion details of TINY

Right: DICKIE, an 18 in. gauge locomotive built at Crewe works, 1878



Below, Fig. 2: The plan view of TINY

the bearing was $2\frac{1}{2}$ in. dia. $\times 1\frac{1}{2}$ in. long, and the coupling-rods were not bushed at all.

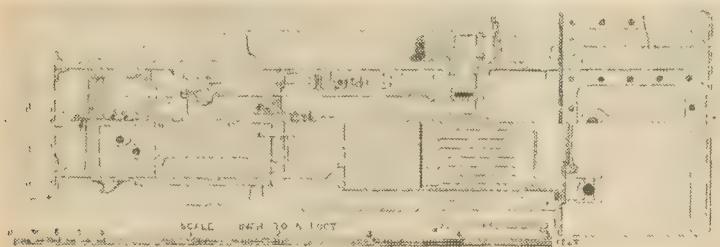
The engine was not sprung in the orthodox sense, but was carried on four rubber pads, each 10 in. $\times 2\frac{1}{2}$ in. $\times 2$ in. deep when loaded.

A SPUR-DRIVEN VALVE GEAR

In 1871, after Mr Ramsbottom's death, Francis William Webb took charge at Crewe and in addition to the numerous famous types of locomotive he designed were some addi-

tional ones for the works narrow-gauge railway, which, by that time, had become extended to a length of over five miles—partly due to the company deciding to manufacture their own steel by the Bessemer process and to the rapid extension of the works area generally.

These newer engines, of which *Dickie*—built in 1878—is an example were an improvement on *Tiny* inasmuch that the link-valve motion was discarded and that reversing was effected mechanically by a pair of



spur wheels. One was keyed to the driving axle and the other—of equal diameter—to a countershaft on each end of which was a small crank which drove the valve spindle on each side of the engine.

The spur wheel on the driving axle was a broad one occupying the space between the two axle main bearings, while the wheel on the countershaft was a narrow one held in position on the shaft and prevented from slipping by a skew key. Thus by traversing the latter wheel across the face of the broad wheel on the key, the relative rotational position of the counter- or valve-shaft was altered, and the engine thereby reversed.

From a model making point of view it is interesting to bear in mind that a model of either *Tiny* or *Dickie* in 7 mm. to the foot scale would run on a track gauge of $10\frac{1}{2}$ mm.—only $1\frac{1}{2}$ mm. wider than that commonly accepted as correct for "OOO" gauge! This contrast gives one some idea of just how tiny *Tiny* really was. □

BRITANNIA SAILS THE ROUND POND



THIS 4 ft model of the Royal Yacht *Britannia* is the fifth ship model which 14-year-old John Dennys, of Bayswater, has completed.

The vessel, which took John four months to build, is fashioned from plywood and balsa which he purchased from money he earned on his daily paper round.

The picture shows John, watched diffidently by a disorderly flotilla of ducks, setting *Britannia* on its maiden voyage on the famous Round Pond in Kensington Gardens.

One of John's "fleet" of models won a prize at last year's Model Engineer Exhibition. □

A lathe you can build

MARTIN CLEEEVE concludes this short series with notes on tailstock design

IT IS rather surprising that, despite the many examples of commercial tailstock body design which are well proportioned, pleasing to the eye and of more substantial build than those designed for early pattern lathes, as soon as the question arises of making one for a home produced lathe, the mind thinks of a base-plate carrying two triangularly-shaped trunnions between which is mounted a length of gas barrel, the whole held together with liberal splashings of brazing metal which, unless the job is camouflaged with paint, gives the appearance of custard having been spilt upon it.

Apart from the, to modern eyes, abominable appearance of such an assembly it is, if not impossible, at least very difficult to make any

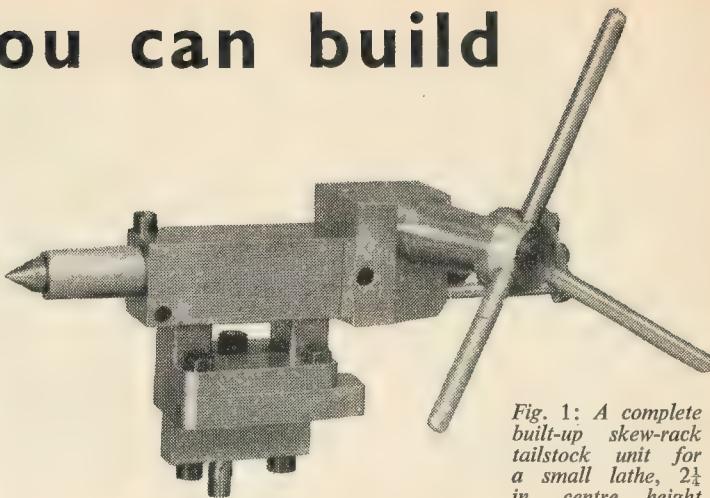


Fig. 1: A complete built-up skew-rack tailstock unit for a small lathe, 2½ in. centre height

adjustments for alignment once the barrel bore has been completed, therefore, unless this operation has been carried out under very precise conditions, the finished job may well result in permanent disappointment.

Agreed, some amateurs are without access to examples of small tailstock design and, therefore, may have to fall back upon those given in machine drawing text books. In this connection, readers will be somewhat amused to hear of my irritation at finding, in quite a modern drawing text book, an example captioned "Tailstock for lathe" which, though shown as a one-piece casting, is not far removed

from the old fashioned triangular trunnion pattern!

To the novice, one of the chief stumbling blocks to the rapid settling of design problems for fabricated structures is that of finding a suitable method for "gaining height" while maintaining lateral and transverse rigidity coupled with decorum in final appearance.

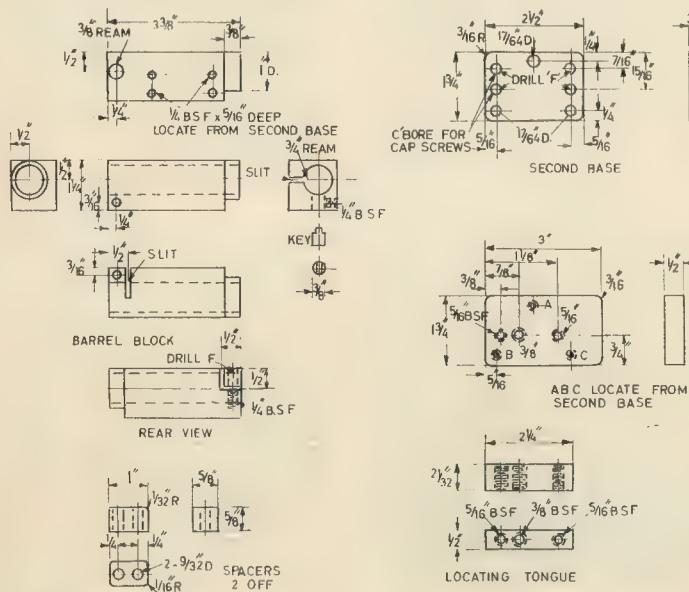
To this problem I am afraid there is no direct answer although I do find it helpful to have an assortment of odd "cut offs" of plates and rectangular blocks the stacking up of which stimulates the imagination. With regard to the question of the strength of materials, such knowledge may be gained from experience, or—less tasteful to many—from textbooks although, as these are sometimes compiled by people who know everything but can do nothing their perusal is not always as beneficial as might be expected.

There seems to be a notion, the origin of which is somewhat obscure, to the effect that components which are screwed together lack strength. On this score, the cast tailstock on my ML7 lathe is a super rigid structure, but it is interesting to reflect upon the fact that, in use, it is held to the lathe bed in a most satisfactory manner by means of only one $\frac{3}{8}$ in. B.S.F. mild-steel nut and screw.

The tailstock body which was ultimately designed for the small lathe proved to be quite rock-like in rigidity and the writer is, therefore, able to recommend it with full confidence. The photograph (Fig. 1) illustrates a complete built-up skew-rack tailstock unit for a $2\frac{1}{2}$ in. lathe.

I suppose it must be admitted that, to some, this will appear to be a rather formidable mass of com-

Fig. 4: The tailstock components



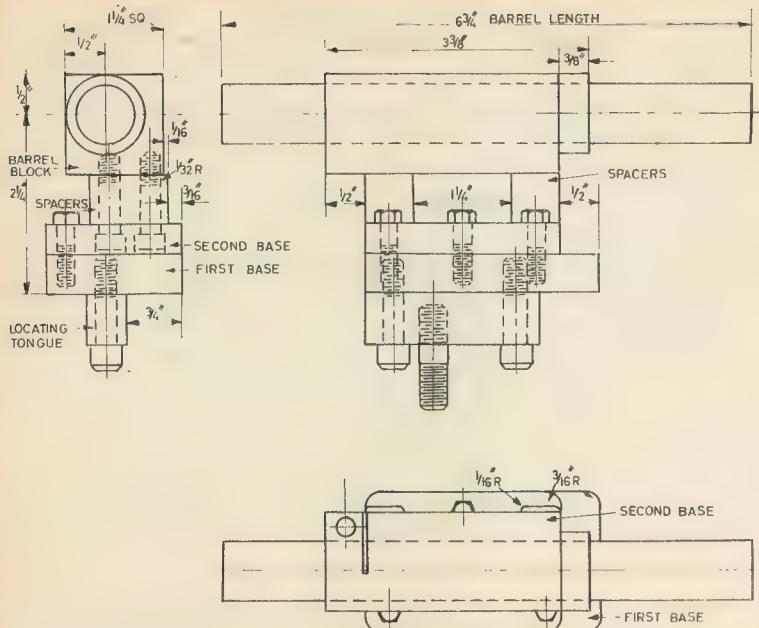


Fig. 3: The tailstock body

ponents. However, a reference to Fig. 2 will show that the body is composed of only six individual pieces of metal which, for convenience, may be divided into two separate assemblies, the base unit being at the left-hand side.

The upper unit is held and adjusted for alignment by means of the three hexagon-headed screws which may be seen in position on the base member. The drawing (Fig. 3) gives the dimensions of the relative positions of the components, while Fig. 4 shows the components themselves.

I should like particularly to draw the attention of the reader to the method of barrel locking and the mode of fitting the barrel key.

The photograph (Fig. 5) includes a rear view of the tailstock body at the upper right-hand side of which will be seen the manner in which the block for the barrel has been slit in order that a portion may be closed on to the barrel by means of a screw. Apart from locking the barrel securely with a minimum distortional strain, a partial pressure may be applied to introduce a measure of uniform sliding friction which is an asset for some kinds of work.

While there are numerous ways of fitting a key to prevent the rotation of a tailstock barrel, it is thought that none is so effective and straightforward as that of forming a projecting tongue upon the end of a piece of round stock, this being accommodated in a close fitting hole and locked by a grub-screw at right angles.

The skew-rack mechanism is a small scale edition of that fitted to my ML7 and the necessary machining operations follow those already described in the two constructional articles dealing with the larger version.

It is realised that some of the complications introduced by this mechanism will not meet with the approval of a number of readers, if only on the grounds that the necessary equipment and gear cutters are not to hand. In this respect, perhaps a little story will not be out of place as a stimulant to the imagination.

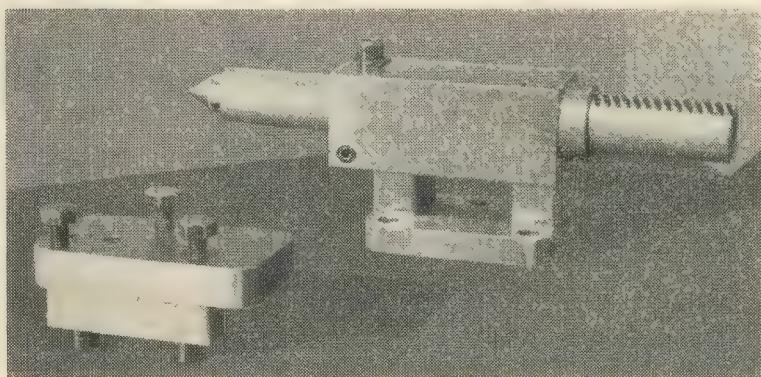
A friend of mine is overhauling and augmenting the equipment on an early Myford ML3. This lathe is of the type where saddle traverse is obtained by means of a pinion meshing with the threads of the leadscrew. Upon calling one day I was shown a very presentable 18 in. length of rack made with view to relieving the leadscrew of the undesirable traversing duty.

Knowing my friend was without the usual means for rack cutting, I lost no time in asking how he had made such a nice job of it. By way of reply he picked up a length of power hacksaw blade over one end of which he had slipped a rubber cycle handlebar grip. . . .

At the time of that particular visit he had not prepared a pinion but, somehow, I do not think he is at all worried over the prospect. On the question of pinions, I often pick up and look thoughtfully at the centre pinion and shaft of an old bicycle three-speed gear which is among my oddments. Cycle dealers will always sell a second-hand one of these for a few coppers.

Agreed, a combination of cycle pinon and hand-cut rack might rumble a little, but I can think of no good reason for the rejection of the idea upon that score; moreover, a rough job has the merit of indicating the full possibilities and showing that

Fig. 2: The two simple assemblies forming the tailstock body



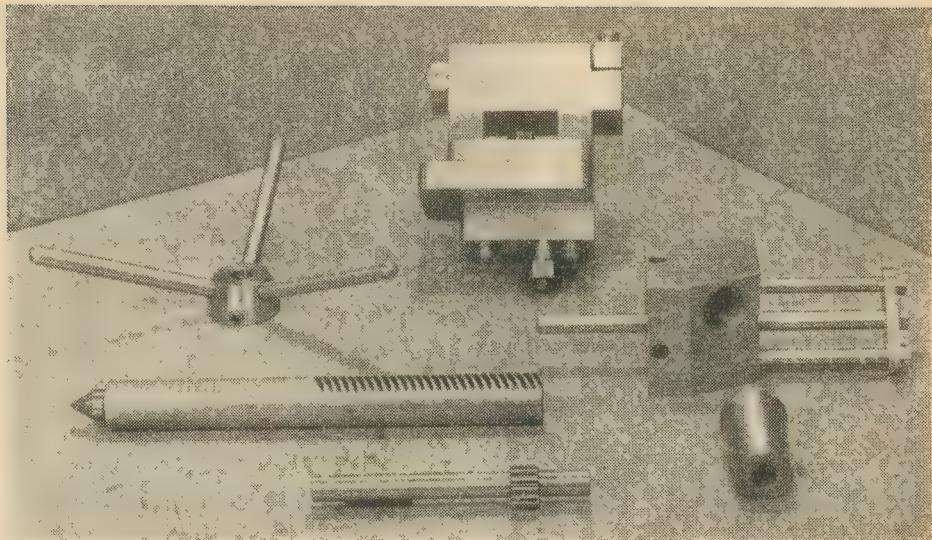


Fig. 5: The tailstock body (rear view) is in the background; in the foreground are typical skew-rack components

time spent upon a precision version will not be time wasted.

In this particular case the tailstock mechanism is mounted directly on to the 1 in. dia. by $\frac{3}{8}$ in. wide projection, or spigot, which is machined upon the right-hand end of the barrel block.

The unit is locked to this by means of four $\frac{1}{4}$ in. B.S.F. hexagon socket-head grub-screws thus eliminating the need for a split clamping ring such as was necessary for the ML7 tailstock.

Those who prefer a screw or lever feed will see that either could be fitted

without much trouble. I think that if the rack mechanism was beyond my means I should choose a lever feed; this would certainly eliminate the somewhat difficult task of machining a thread (and wheel nut) of suitably coarse pitch. □

WATERPROOF plywood has been used with success in the building of small boats for many years. Now a new type of plywood has been put on the market especially for the energetic mariner who prefers to build his own craft.

Manufactured by Venesta, Permaply is not only waterproof it is also rot-proof. In addition to protecting boats built of it from the water and the weather it also preserves them against the ravages of corrosion.

Stringent tests have been made with a sample of Permaply taken at random from stock. Together with a piece of untreated plywood it was buried in waterlogged ground for 3½ years, regular inspections being carried out to assess the degree of deterioration.

The ordinary plywood rotted and delaminated quickly,

ROT-PROOF PLYWOOD FOR SMALL BOATS

but the Permaply, though slightly discoloured, remained basically intact after years in the damp soil.

A 25 m.p.h. speedboat, mainly built of this material, has been made for Mr Miles Edwards, of Bolton, by a team of amateur craftsmen who had no previous experience of boat building. They found the material easy to work and possessing definite advantages.

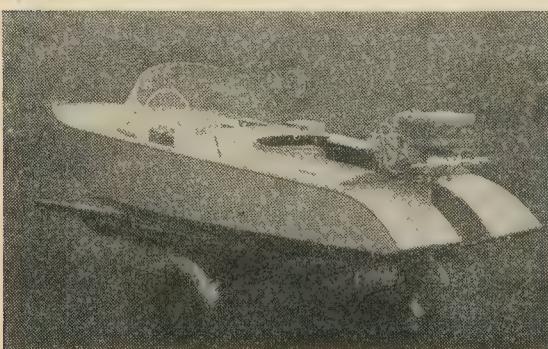
Single sheets of Permaply were used to form a simple skin for the sides and bottom, the sheets being fitted tightly and held in place by a cement glue and screws. This system was less complicated than either the carvel or clinker methods of construction.

The boat, *Silver Spray*, has an overall length of 13 ft and a beam of 4 ft 9 in. Being a skimming craft, the V-bottom tapers off to almost a flat base at the transom.

There are two cockpits: one seats the driver and passenger, and the other is aft for the person who tends the outboard motor mounted on the transom. Sponsons skirting the engine act as buoyancy tanks, and a water-tight compartment forward of the front cockpit also forms another buoyancy tank.

Silver Spray is propelled by a pre-war Johnson four-cylinder, two-stroke, water-cooled engine developing 32 b.h.p. at 5,000 r.p.m.

Permaply is made in this country from high-quality sheets of West African hardwood ply impregnated under pressure with phenolic formaldehyde resin. □



VIRGINIA

L.B.S.C. now gives instructions for making up the tender tank and the fittings that go inside it

COMPARED with the average British tender body of contemporary vintage, *Virginia's* tender tank may seem rather awkward to make and erect . . . the way I managed to get the exact shape of the last one I made to this pattern many years ago was to mark out the plan of the tank on a piece of cardboard, cut it to outline and bend my strip of metal, using the cardboard as a gauge. As I had a strip long enough for the whole job I made the joint in the middle of the narrow end of the coal recess. The ends were butted together and secured by a butt strip on the water side of the joint.

If builders of this engine find that their strip of 18- or 20-gauge brass, $2\frac{1}{4}$ in. wide, isn't long enough, make the tank in two halves, with the second butt joint in the middle of the back. Both halves will be identical and the curves can still be bent to the cardboard template. To form the radii just bend them by hand around

a piece of 1 in. round bar held horizontally in the vice jaws.

Both butt strips should be about $\frac{1}{2}$ in. wide, and they can be held in place with toolmaker's cramps, tacked with soft solder and then riveted up with $\frac{1}{16}$ in. brass or copper rivets. They can be finally sweated watertight with the rest of the tank joints.

Pieces of $\frac{1}{4}$ in. $\times \frac{1}{16}$ in. angle are riveted for nearly the full length of the tender—top, bottom, back end—and along the straight part of the end of the coal recess. Those at the bottom should be flush with the edge, but those along the top should be a bare $\frac{1}{16}$ in. below the edge so that the top-plate, when screwed down to them, does not project above the sides. Drill a series of holes about 2 in. apart in all the bottom angles, using a No 48 drill, but put an extra one in the bit of angle at the end of the coal recess.

The body can now be erected on the soleplate, and be mighty careful to locate it as shown so that the body curves tally with those on the soleplate. If you haven't any cramps big enough to hold it tack it with solder

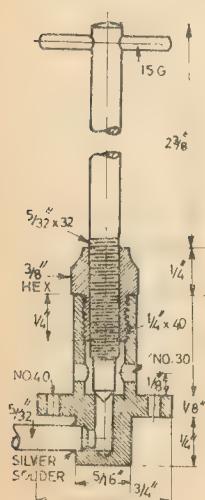
at each end. Then, using the holes in the bottom angles as a guide, make countersinks with a No 48 drill in the soleplate. Drill these through with a No 53 drill, tap 9 B.A. or 2/56 and put brass screws in. Beginners will probably wonder how they are going to get a No 48 drill to the holes in the angles when they are almost touching the tank sides. Well, just chuck a piece of $\frac{3}{16}$ in. brass or steel rod in the three-jaw, say about 3 in. long, face the end, centre and drill to about $\frac{5}{16}$ in. depth with a No 49 drill. Drive the fluted piece of the last No 48 drill you broke into the hole, business-end outwards, and use it by holding the rod in the hand-brace. You not only reach the holes, but save money in the bargain. Incidentally, it is a good idea to mount all bits of broken drills in this manner, as they can be used right up in drilling-machine, lathe, or hand-brace.

The next job is to sweat up the tank to make it watertight. Do this as far as possible from the inside for neatness. I just brush some liquid soldering flux (don't use paste) along the bottom, all around and over the angles and use two bits, working with one while the other is heating in the fire. This makes the job practically non-stop, and the metal doesn't cool off. The solder runs easily and covers all rivet and screwheads. Sweat up the butt strips as you come to them. But do not be tempted to warm up the job with a blowlamp or blowpipe before applying the soldering-bits; if you do the chances are that the brass sheet will distort and you will never get it flat again. Wash away all traces of the flux with hot water, and if any solder has seeped through to the outside scrape it off. The best tool for this is an old flat file with the teeth ground off at the end. I use one of my old worn-out 8 in. files for jobs like this.

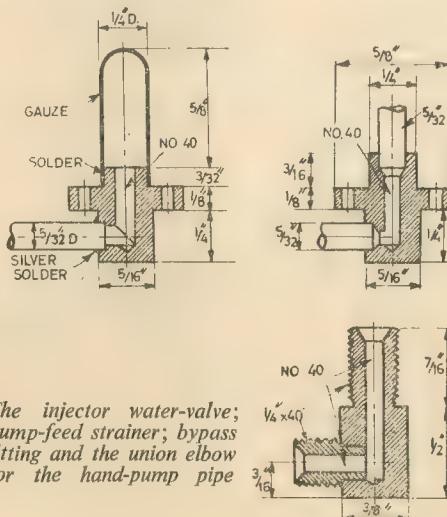
EMERGENCY HANDPUMP

The fittings required inside the tank are a hand-pump for use in emergency, a water valve to regulate the supply to the injector, a feed-water strainer for the eccentric-driven pump, a flange fitting for the bypass pipe and a union elbow for the hand-pump feedpipe. I have shown these separately in full detail.

The handpump can be made from a casting or built up. The bottom of a casting, if clean, can be trued up by rubbing it on a big flat file laid on the bench otherwise chuck it in the four-jaw and face off the bottom. Drill a No 40 hole at each corner. Chuck the end of the barrel in the three-jaw, set it to run truly, face off the outer end, centre, drill through with $27/64$ in. drill and ream $\frac{7}{16}$ in. Mount it on a stub mandrel for facing the other



The injector water-valve; pump-feed strainer; bypass fitting and the union elbow for the hand-pump pipe



VIRGINIA . . .

end to $1\frac{1}{8}$ in. length, smooth off both sides of the anchor lug on top of the barrel and drill it No 30.

For the valve box chuck a piece of $\frac{7}{16}$ in. brass rod, face the end and part off a $1\frac{1}{8}$ in. length. Rechuck, centre, drill right through with a No 23 drill, open out and bottom to $\frac{5}{8}$ in. depth with $9/32$ in. drill and D-bit and tap $\frac{5}{16}$ in. \times 32. Reverse in the chuck and repeat the operation, but instead of using the D-bit nick the end of the hole with a little chisel which can be made from a short bit of $3/32$ in. silver-steel. In the side, halfway along, drill a $5/32$ in. hole and tap it $\frac{5}{16}$ in. \times 40. Finally, put a $5/32$ in. parallel reamer through the remnant of the No 23 hole. Chuck a piece of $\frac{1}{2}$ in. brass rod, face, centre, drill No 40 for $\frac{1}{2}$ in. depth, turn down $\frac{1}{4}$ in. of the end to $\frac{5}{16}$ in. dia. and screw it $\frac{5}{16}$ in. \times 40, then turn down the next $\frac{1}{4}$ in. to a drive fit in the pump barrel. Part off at $\frac{3}{16}$ in. from the shoulder, squeeze the piece into the end of the barrel, screw the valve box on to it (making sure that the D-bitted end is uppermost) and solder over the joint.

Seat a $\frac{3}{16}$ in. rustless steel ball on the seating and take the depth as described for the engine pump. Chuck a piece of $\frac{7}{16}$ in. hexagon rod, face, centre deeply with size E centre drill, drill No 40 for $\frac{3}{8}$ in. depth, turn down $\frac{1}{4}$ in. length to $\frac{1}{2}$ in. dia. and screw $\frac{1}{4}$ in. \times 40 and part off at $\frac{3}{8}$ in. from the shoulder. Reverse in the chuck, holding in a tapped bush, turn down the length indicated by the depth gauge to $\frac{5}{16}$ in. dia. and screw $\frac{5}{16}$ in. \times 32, skim $1/32$ in. off the end and cross-nick it.

Drop a ball in the other end and take the depth. Chuck the hexagon rod again, face, centre, drill No 23 for $\frac{1}{2}$ in. depth, turn down the length indicated by the depth gauge to $\frac{5}{16}$ in. dia. and screw $\frac{5}{16}$ in. \times 40. Face $1/32$ in. off the end and part off at $\frac{1}{4}$ in. from the shoulder. Reverse in the chuck, turn the end as shown, cross-nick it and put a $5/32$ in. parallel reamer through. Seat a ball on the screwed end and assemble the lot as shown.

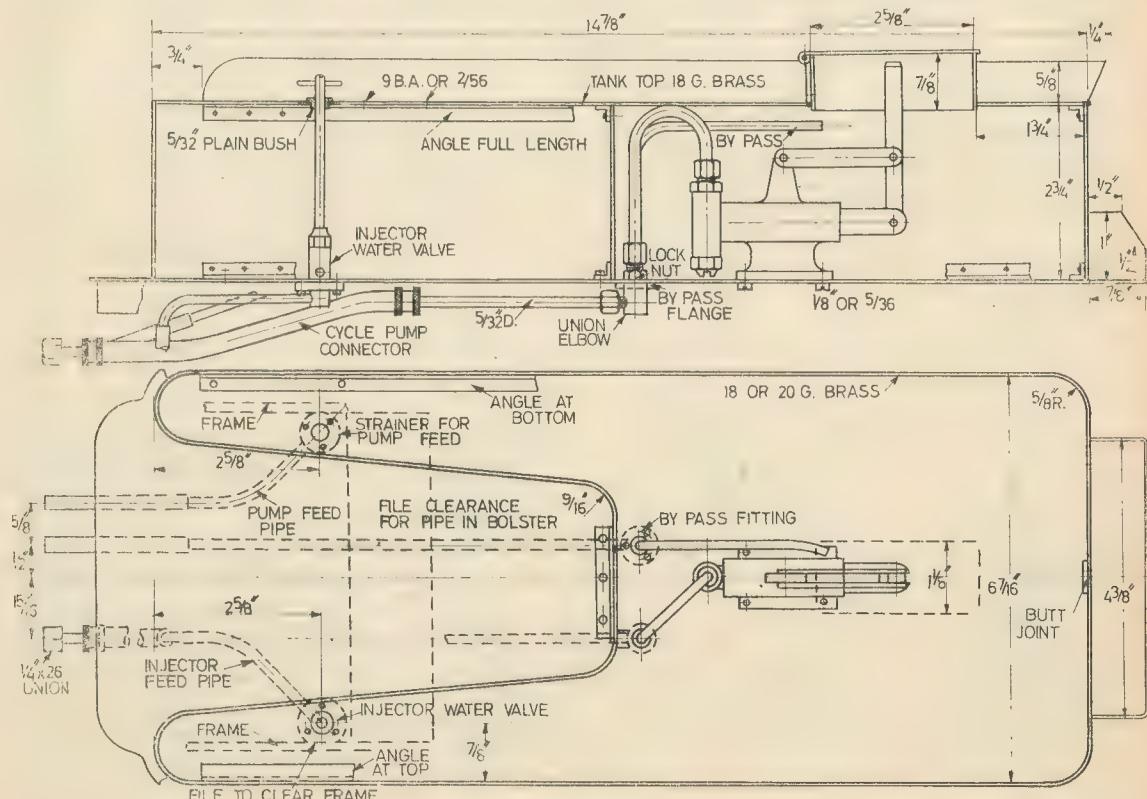
The ram is a piece of $\frac{7}{16}$ in. rustless steel or phosphor-bronze $2\frac{1}{2}$ in. long and, if a good sliding fit, needs no turning. Round off one end and cut a $\frac{1}{2}$ in. slot in it $\frac{1}{2}$ in. deep by the method described for valve-gear forks

and similar slots. Cross-drill it with a No 31 drill. At $\frac{1}{8}$ in. from the other end turn a groove $\frac{1}{8}$ in. wide and deep, and pack it with a strand unravelled from full-size hydraulic pump packing if available; if not, use graphited yarn.

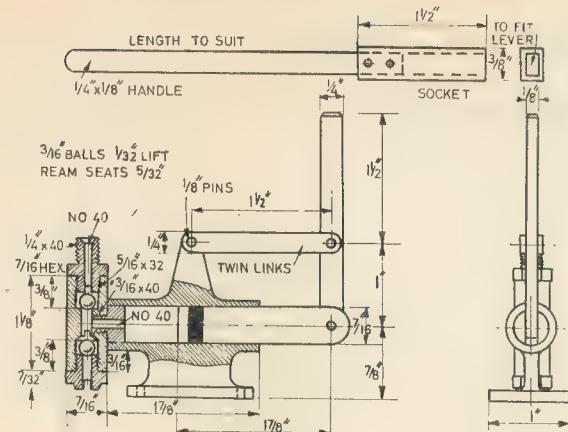
The lever is a $2\frac{1}{2}$ in. length of $\frac{1}{4}$ in. \times $\frac{1}{8}$ in. rod, nickel-bronze for preference, drilled No 30 at points shown. The twin links are made from $\frac{1}{4}$ in. \times $\frac{1}{16}$ in. similar material, but brass will do if nothing better is available. The pins are $\frac{1}{8}$ in. drawn bronze rod. They should be a drive fit in the links and easy in the lever, but if slack in the links just rivet the ends over a shade. The extension is simply a piece of rod of the same section as the lever, any length desired, with a socket on the end, $1\frac{1}{8}$ in. long, to fit over the lever. This may be a piece of rectangular brass tube (commercial article) or bent up from 16-gauge sheet, the joint being silver-soldered.

INJECTOR WATER-VALVE

Chuck a piece of $\frac{3}{4}$ in. round rod in the three-jaw, face the end, centre and drill to $\frac{7}{16}$ in. depth with a No 40 drill. Open out and bottom to $\frac{9}{16}$ in. depth with $7/32$ in. drill and D-bit and tap $\frac{1}{4}$ in. \times 40 for half the depth.



Right: The emergency hand-pump



Below, left: The section and plan of the tank, with fittings

Turn down $\frac{3}{16}$ in. length to a bare $\frac{3}{8}$ in. dia. and part off at a full $\frac{3}{8}$ in. from the shoulder. Reverse in the chuck and turn down a full $\frac{1}{2}$ in. length to $\frac{5}{16}$ in. dia. At $\frac{1}{8}$ in. from the shoulder on the long side drill No 30 right through as shown. At $\frac{1}{2}$ in. from the shorter end, drill a No 40 hole, breaking into the central hole, open out with a No 23 drill for about $\frac{1}{8}$ in. depth and silver-solder a piece of $5/32$ in. copper tube about $3\frac{1}{4}$ in. long into it. Drill three No 40 screw-holes in the flange.

Chuck a piece of $\frac{3}{8}$ in. hexagon rod, face, centre, drill to $\frac{3}{8}$ in. depth with a No 31 drill, turn down $\frac{1}{2}$ in. of the outside to $\frac{1}{2}$ in. dia. and screw $\frac{1}{8}$ in. \times 40. Part off at $\frac{1}{2}$ in. from the shoulder, reverse in the chuck, bevel off the end and run a $5/32$ in. \times 32 tap through.

The valve spindle needs a piece of $5/32$ in. round bronze or rustless steel, $3\frac{1}{4}$ in. long. Chuck in the three-jaw and turn a blunt cone point on the end. Screw $5/32$ in. \times 32 for 1 in. length, then turn away the threads for about $\frac{1}{2}$ in. as shown. Reverse in the chuck, face off the other end and slightly bevel it. Drill a No 50 crosshole about $\frac{1}{8}$ in. from the top and squeeze in a $\frac{1}{8}$ in. length of 15-gauge spoke wire, with the ends rounded off to form the handle. For the bush chuck a piece of $\frac{3}{8}$ in. rod, face, centre and drill No 21 for $\frac{5}{16}$ in. depth. Turn down $\frac{1}{2}$ in. length to $\frac{1}{2}$ in. dia. and part off at $\frac{1}{2}$ in. from the shoulder.

The other fittings

To make the strainer for the engine-pump feed chuck a piece of $\frac{3}{8}$ in. brass rod, face, centre, and drill to a bare $\frac{1}{2}$ in. depth with a No 40 drill. Turn down $3/32$ in. length to a bare $\frac{1}{2}$ in. dia. and part off at $\frac{3}{8}$ in. from the shoulder. Reverse in the chuck,

holding only a bare $\frac{1}{2}$ in. of the rod in the chuck jaws, setting the piece to run truly and then tightening the jaws up well; then turn $\frac{1}{2}$ in. length to $\frac{1}{16}$ in. dia. Drill the boss and fit a piece of $5/32$ in. copper tube to it, exactly the same as the bottom of the injector water-valve. Roll up a piece of fine-mesh copper or brass gauze into a finger $\frac{1}{2}$ in. dia. and about $\frac{1}{2}$ in. long, fit it over the drilled end of the fitting and soft-solder it.

The bypass fitting is very similar. Chuck the $\frac{3}{8}$ in. rod again and drill it No 40 for $\frac{1}{16}$ in. depth. Turn down $\frac{3}{16}$ in. length to $\frac{1}{2}$ in. dia., then counterbore the hole for $\frac{1}{2}$ in. depth with a No 23 drill and part off at $\frac{1}{2}$ in. from the shoulder. Reverse in the chuck and repeat the operation described for the bottom of the strainer. Both this and the bypass fitting need three No 48 holes drilled in the flange for the screws.

In the side hole at bottom of fitting, silver-solder a piece of $5/32$ in. copper pipe 7 in. long. In the upper hole fit a 5 in. length and silver-solder that at the same heat.

For the union elbow chuck a piece of $\frac{3}{8}$ in. round rod, face, centre deeply and drill No 40 to $\frac{3}{8}$ in. depth. Turn down $\frac{7}{16}$ in. length to $\frac{1}{2}$ in. dia. and screw $\frac{1}{8}$ in. \times 40. Part off at $\frac{1}{2}$ in. from the shoulder. Drill a $\frac{1}{16}$ in. hole in the side at $\frac{3}{16}$ in. from the bottom and in that silver-solder a $\frac{1}{2}$ in. \times 40 union nipple. Make a lock-nut for the stem from $\frac{3}{8}$ in. hexagon rod, which needs no detailing out.

THE TANK TOP

The top of the tank can be made from a single sheet of 18-gauge brass—it can be thicker, but not thinner otherwise it may sag—and to get it an exact fit trim up the cardboard template used to get the correct shape of the body until it fits nicely in the

tank, resting on the top angles. Then take a leaf from the fretsaw worker's book; stick the pattern on the sheet of brass and cut it to the outline of the pattern with a metal-cutting fretsaw or a piercing-saw. I do this kind of job on my Driver jigsaw, which goes through 18-gauge brass at an amazing speed. Smooth off the sawmarks with a fine file and the brass top should be a perfect fit in the tank. This method is far better than cutting with shears to a marked line, as there is no distortion of the metal and the minimum of waste.

At $1\frac{1}{2}$ in. from the back end on the centre line, cut an opening $1\frac{1}{8}$ in. wide and not less than $2\frac{5}{8}$ in. long, with slightly rounded corners. It may be longer if desired. This can also be cut out with a piercing-saw. Cut a strip of sheet brass $\frac{3}{8}$ in. wide and approximately $7\frac{1}{2}$ in. long and bend it to the shape of the hole into which it is fitted, with the joint at the front end. It should project through about $\frac{1}{16}$ in. and is soldered in place from the underside. A lid with about $\frac{1}{16}$ in. overlap can be cut from the same kind of metal; leave two $\frac{1}{8}$ in. tags at one end when cutting out, about $\frac{3}{8}$ in. apart, and bend them into loops with roundnose pliers. Bend a similar loop at the end of a short strip $\frac{3}{8}$ in. wide, fit it between the loops on the lid, put a piece of wire through for a pin—and there is your hinge. The strip is riveted to the front end of the filler, as shown in the section of the tank.

Drill a series of No 48 holes along each side of the tank top; $5/32$ in. from the edge at about $1\frac{1}{2}$ in. centres. Do this also at the back of the coal recess. Put the tank top in position and run the drill through all the holes, making countersinks on the angles. Remove the top, drill the countersinks No 53 and tap 9 B.A. or 2/56.

ATTACHING THE PUMP AND FITTINGS

Set the pump lever vertical and stand the pump in the tank so that the lever will come exactly under the centre of the filler, as shown in the section. Run a No 40 drill through the holes in the base and make countersinks on the soleplate. Remove the pump, drill the marked spots with a No 30 drill, tap the holes in the pump base $\frac{1}{8}$ in. or $5/36$, and fix the pump with brass screws to match put in from underneath.

At $2\frac{5}{8}$ in. from the front of the left-hand water leg of the tank and $\frac{7}{8}$ in. from the side (see plan) drill a $\frac{3}{8}$ in. hole. At the corresponding place on the tank top drill a $\frac{1}{2}$ in. hole. Remove the spindle from the injector water-valve and take out the screwed top. Insert the valve body from under-

Continued on page 478

Drilling deep holes in hardwoods

J. NIXON overcomes the problem of boring the long hole through a lamp standard

THE RESOURCEFULNESS and ingenuity of the home-workshop owner is well established. Nevertheless there are times, when model engineers, including those of us with years of experience, give consideration to some project or other only to decide that the job entails one or more operations which are not within the reasonable scope of the tools available.

Reluctantly the idea goes back into the pigeonhole with a pious promise that it will be dusted off and reconsidered at some future date. Too often that day never comes.

I took one such dusty project out of its resting place recently—a tall standard lamp. To those who are woodturners and owners of long-bed wood lathes, augers and the like, perhaps the problem I am about to present will not arise.

In its essentials the "thing" had to stand about 5 ft from the floor to the lampholder, and it had to be of *hardwood*, not just oak, mahogany, or teak but something really granite-like and close-grained, like lignum, ebony, blackwood, macassar or rosewood, the reason for this preference being that the finished article had to be ornamented.

The outstanding problem which presented itself was to bore a hole of sufficient diameter to pass twin flex through. This operation was complicated by the fact that materials being somewhat expensive, the hole had to be bored reasonably truly, and tools and rig needed to be accurate.

In sections

One factor may be said to reduce the odds somewhat; for convenience it is not unusual to make such a standard as I had visualised in at least two lengths: a base of about 6 in. in depth, a centre piece of 6 in., and two main pieces of 24 in. each in length, so making up the total of 5 ft decided upon.

In the final assessment the problem was reduced to drilling through 24 in. of hardwood using a lathe 24 in. between centres; that is to say the distance between the point of a drill held in the s.c. chuck and the tailstock centre would certainly be inches short of 24!

The operation was carried out on a 5 in. Little John lathe, and any dimensions given hereafter have particular reference to such a machine. Too often writers deliberately omit all dimensions, remarking that as the devices described were made to suit some specific machine or purpose any sizes given would be of little help to others. Such an assumption often leaves the reader, particularly those of us who are not so "up" in the back-room arts, without any basis on which to start an adaptation of the contrivance—which is analogous of a learner driver asked to find his way across a desert! The dimensions given here, therefore, are signposts.

Before going further it should be made clear that it is essential that the lathe be provided with a hollow mandrel for reasons which will become clear later.

Turning the roughs

One of the basic sizes of the standard was $2\frac{1}{8}$ in. dia. at its largest part, and the two pieces of timber should be turned between centres to this size, parallel for the time being, the upper and lower pieces being approximate duplicates in the rough.

First of all a clamping cradle to hold these somewhat hefty pieces of timber is devised. For this purpose you will need two pieces of sound oak, each 6 in. $\times 4\frac{1}{2}$ in. $\times 1\frac{1}{2}$ in. One of the 6 in. $\times 1\frac{1}{2}$ in. faces on each piece needs careful planing and smoothing to a bedding on the boring table. Two $\frac{7}{16}$ in. holes are bored vertically on $3\frac{1}{2}$ in. centres—this, to suit the spacing of the T-slots in the table.

On a centre line corresponding to the height of the lathe centre above the table top bore a large hole, up to 2 in. say, with an auger or expanding bit, or by any other available means, as accuracy is not critical at this point. (Fig. 1).

The two pieces of oak are now mounted transversely on the boring table, one each in line with the front and trailing edges of the table respectively. For securing them in place, $\frac{3}{8}$ in. bolts inserted from the top and engaging in square nuts located in the T-slots are used; the reason for this particular arrangement will become clear later.

A boring bar 1 in. dia. $\times 12$ in. is always a useful accessory to a

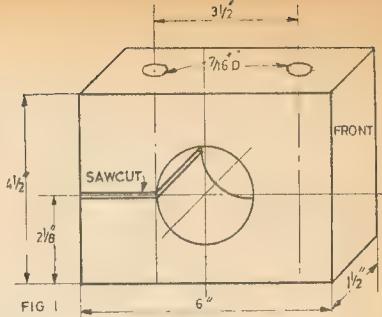


FIG. 1

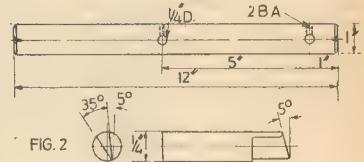


FIG. 2

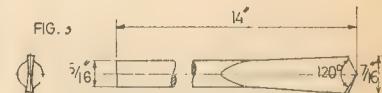


FIG. 3

Figs 1, 2 and 3: The clamping block; the boring bar; and the long drill

lathe and if you have not got one now is the time to make one, as shown in Fig. 2. Incidentally, apart from its boring duties it can be used on a test bar when re-aligning the lathe centres after the tailstock has been set over for taper turning.

A cutting tool of $\frac{1}{4}$ in. dia. silver steel is easily and quickly made with a file, tempered to a dark straw, honed and secured in the boring bar. The bar is mounted between centres, with a driver at the headstock end, and the tool is set by stages to bore out the clamping blocks to the full diameter; the lathe should be run at high speed during this operation.

You should now have a smooth accurate bore in both blocks through which the standard "rough" should be a sliding fit. Now remove the back bolt from each of the clamps, first ensuring that the front bolts are tight enough to prevent the blocks from moving.

Using a tenon saw, cut through each block from the back along a horizontal centre line into the centre bore. This operation obviously could be carried out prior to mounting the blocks, providing that packing is inserted in the saw cuts before bolting down. Anyway, the blocks can be cut as far as the boltholes beforehand, which arrangement ensures security for boring as well as reducing the rather awkward job of sawing in what may be a confined space.

If one of the standard sections is set up in the clamping blocks it will be found that a moderate nip on the back bolts ensures that the work is held very securely in accurate alignment.

ment with the lathe centres.

At this point by no means in apparent sequence, we should take a look at the tool which enables the deep drilling to be accomplished. This tool is very easy to make as, in essentials, it is nothing more than a spear-point drill. Take a piece of straight, bright mild-steel rod, $\frac{1}{16}$ in. dia. $\times 14$ in.—and check that it is straight by running it in the chuck and holding it successively at several points along its length. Slight deviations from truth can usually be corrected quite easily by judicious use of manual pressure applied in the right direction.

Heat one end of the rod and beat it out flat until the end is about $\frac{1}{2}$ in. broad. When it is cool grip the rod in the s.c. chuck, and again ensuring reasonable concentricity turn the flattened end until it measures $\frac{7}{16}$ in.; then turn the end to a contained angle of 120 deg. swinging the topslide over to an angle of 60 deg. The resulting point will be the apex of a flat cone which should be used as a reference point from which to file the cutting edges (Fig. 3). The point could with advantage be case-hardened but this

is not essential for a "one-off" job.

Now to the drilling operation. Remove the tailstock from the lathe bed and mount the work in the clamping blocks so that it protrudes 4 in. to 6 in. towards the headstock. Start the hole with a standard $\frac{1}{16}$ in. twist drill held in the chuck and drill as deeply as possible, 3 $\frac{1}{2}$ in. to 4 in. say, by racking the work up to the drill; the turning centre will ensure a true start.

Run the lathe at a moderate speed and withdraw the work from the drill at frequent intervals; with hardwoods considerable heat is generated and the swarf has a tendency to coagulate into a solid mass on the first inch or so of the drill.

Having penetrated to the full working depth of the twist drill, transfer to the spear point, gripping it in the chuck about 6 in. behind the point. Still using moderate speeds and withdrawing at frequent intervals, $\frac{1}{2}$ in. to $\frac{1}{4}$ in. penetrations is possible at each pass; the overhang of the drill is increased as it becomes necessary, until a depth of slightly over half the total length of the work has been attained.

At this point release the clamping blocks and reverse the work, again ensuring that the front bolts are tight before slackening those at the back. Repeat the above operations and the end result should be a true hole throughout the length of the work.

As the drill approaches its maximum penetration, and in particular when returning it into the hole after clearing the point, there may be a tendency for it to chatter. This may be controlled by sleeving a flanged brass bush over the drill shank, the bush being an easy fit on the drill and in the bored hole; the purpose of the flange being to prevent the bush from going into the hole.

There is no doubt that the hole could have been drilled through the standard in one setting had the drill been made long enough in the first place, but drilling from each end in turn does, in fact, ensure concentricity at the ends from which to complete turning and succeeding operations; on the other hand, in drilling right through at one setting, there might be a risk of the drill's running off slightly and so making it somewhat awkward to correct for finish turning. □

VISITORS to model exhibitions often complain that, though the models on show represent marvellous examples of skill and precision, there is little to attract the average layman. To disprove this the Northern Models Exhibition, due to open its doors on March 29, will have a large proportion devoted to working model attractions and other demonstrations specially provided to interest the man in the street.

Following its success last year, the boat pond is to be installed again and the members of the Manchester group of the I.R.C.M.S. will be showing their radio-controlled boats in action. A new feature this year will be a new working model race car track based on the recently introduced electrically-driven rail racing system.

Visitors will be reminded of the summer holiday period when they see Mr Howard, of Manchester, operating his model Blackpool tramway layout against a scenic background reminiscent of this famous resort. Another popular item at any show is Mr F. Pain's demonstration of wood turning, at which he is an acknowledged master. Other attractions will include demonstrations of metal turning and typical examples of engineering work in progress.

For the enthusiasts there will again be a large range of models, varying from tiny ship miniatures to a large model locomotive $7\frac{1}{2}$ in. gauge over 8 ft long. In the locomotive section, live steamers will have the opportunity of comparing two un-

NORTHERN MODELS EXHIBITION

finished $\frac{1}{4}$ in. scale Duchess class locomotives, one by Alan Green, of Swinton, and the other by David Woolfenden, of Rochdale.

Another entry in this section is the completed 0-6-0 tank locomotive by E. Younghusband, of Eccles, to the *Twin Sisters* design of Mr. J. I. Austen-Walton.

There will be a large variety of

Mr Tatlock's finely detailed model motorcycle and, below, Mr Howard, of Manchester (in front, left), with his working model tramways layout

entries to be seen in the general models section including a fine $2\frac{1}{2}$ in. scale model of a Fowler 8 h.p. road engine built by Mr R. S. Jaques from an original delivered to a firm in Boston, Lincs in 1904.

Motorcycle fans will be particularly interested in Mr L. Tatlock's quarter-size replica of a Francis Barnett. □



EXPERT'S WORKSHOP

Duplex concludes . . .

Making a wobble saw

After the collar, *A*, has been mounted in the four-jaw chuck and centred with its drilled bore running truly, a small boring tool is used to enlarge the bore until its diameter is one thou. less than that of the arbor, so as to give an interference fit when the collar is pressed into place against the shoulder of the arbor by tightening the clamping nut.

It should be noted that this collar is located with its point of greatest width opposite the keyway already machined in the shank of the arbor; this is to ensure that the key fitted to the collar, *D*, is supported by an ample thickness of metal.

The next operation is to locate and to fit to the collar, *D*, the shouldered screw which is shown in Fig. 10 and serves as a key. This screw must be accurately located in order that the inner abutment surfaces of the two collars, *A* and *D*, lie parallel after assembly and remain so while any adjustment of the cutter setting is made.

For this purpose (Fig. 9) these two collars are rested on the surfaceplate with their datum faces downwards. With the arbor supported by means of one or a pair of V-blocks the scribe of the surface gauge is set in turn to either edge of the arbor keyway and corresponding lines are scribed on the collar, *D*, in accordance with the lower drawing of Fig. 9.

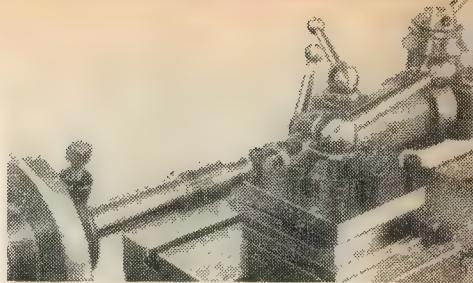


Fig. 12: Engraving the graduation lines

From these scribe marks the drilling centre for the grub screw key is marked out and a hole is step-drilled and afterwards tapped for the 4 B.A. shouldered screw. This screw is made an accurate sliding fit in the arbor keyway to ensure positive location of the collar; in these circumstances, to avoid wear, it is usually best to turn the screw point oversize and to carry out the fitting by filing flats on opposite sides of the screw's dog point.

With all four collars in place and the clamp nut and sleeve fitted to the arbor, the work is again rested on the surface plate so as to align the two inner collars by their datum surfaces. The collars are now securely fixed to

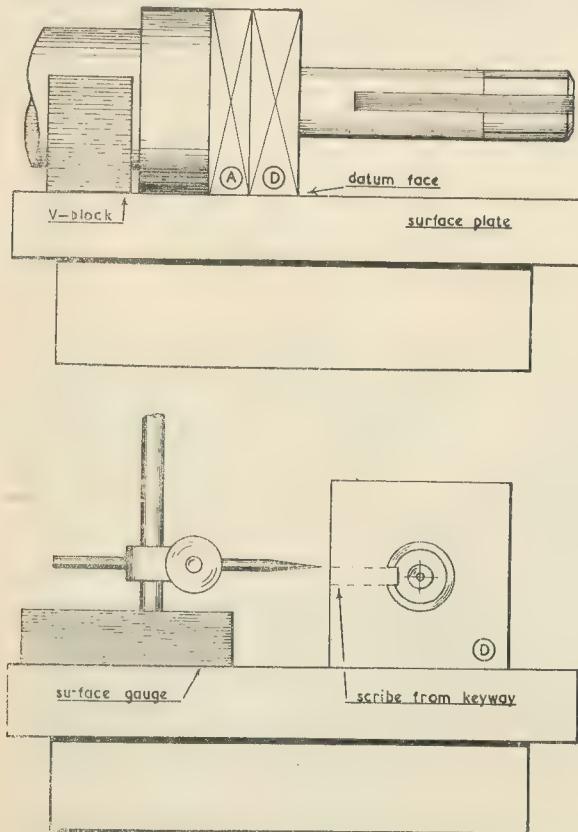


Fig. 9: Showing the collars set up on the surfaceplate for locating the key

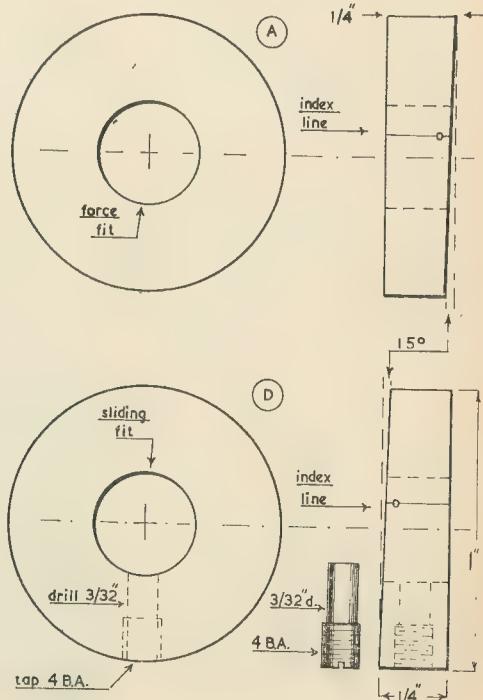


Fig. 10: Showing the dimensions of the two outer collars (*a*) and (*d*)

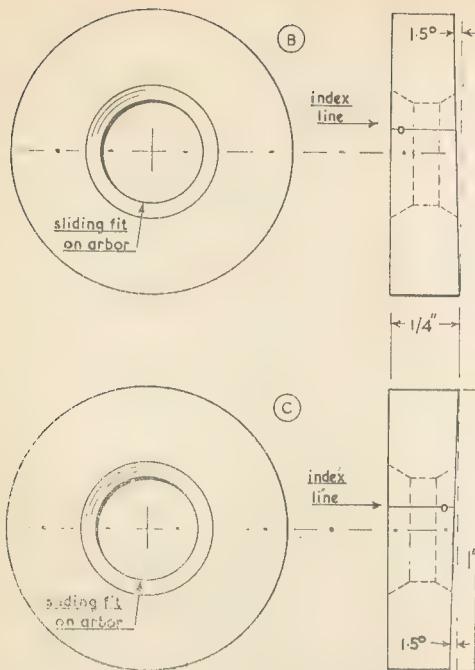


Fig. 11: The two inner collars (b) and (c); Fig. 13: The engraving tool used; Fig. 16: Method of calculating the width of slot machined with the wobble saw

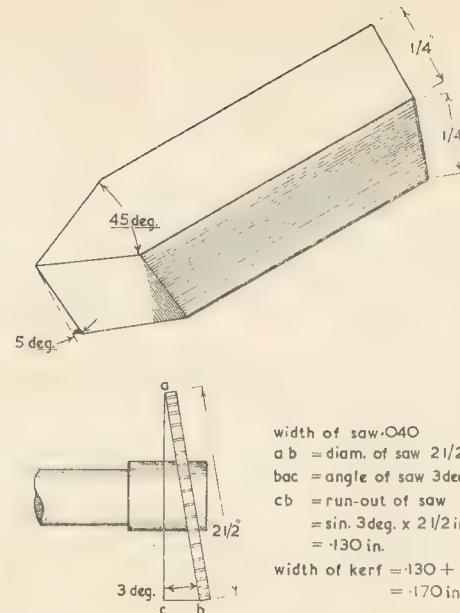
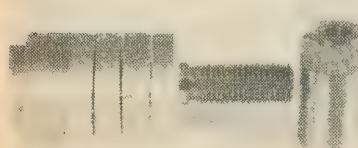
the arbor by gripping the end of the shank in the bench vice and firmly tightening the clamping nut.

Following this, the assembly is mounted between centres in the lathe and a series of light cuts is taken over the work until the four collars are machined all over and reduced to approximately 1 in. dia.

To enable the collars to be reset to zero, when the cutter is required to run truly and without wobble, an index line is engraved across all four collars while the work is still mounted between centres.

When carrying out engraving of this kind it is essential to use a correctly-shaped cutting tool and to ensure that both it and its mounting do not lack the necessary rigidity for machining graduation lines that are cleanly cut and engraved deeply enough for clear reading even after the removal of surface burrs.

Fig. 14: The finished collars mounted on the arbor



engraved to the required depth.

To finish the graduations the zero line on all four collars is marked with the numeral 0 by means of a hand stamp.

Burrs are cleaned off with a jeweller's file and the surface of the work is finished with a strip of worn abrasive cloth. Lines engraved in the above manner will hold a filling of special wax to make them stand out.

The accuracy of the finished arbor should be tested by clamping a circular saw or milling cutter in place and mounting the arbor between the lathe centres. With the collars set in the zero position it was found in the present instance that on applying the test indicator to the face of the cutter no appreciable deflection of the pointer occurred when the lathe mandrel was turned slowly by hand.

The required degree of run-out or wobble of the cutter can be set by taking a direct reading with the test indicator or, as represented in Fig. 16, the width of the kerf or slot cut can be determined by a simple calculation once the value of the angular deviation is known. □

Fig. 15: Machining a keyway with a narrower milling cutter



Model boat



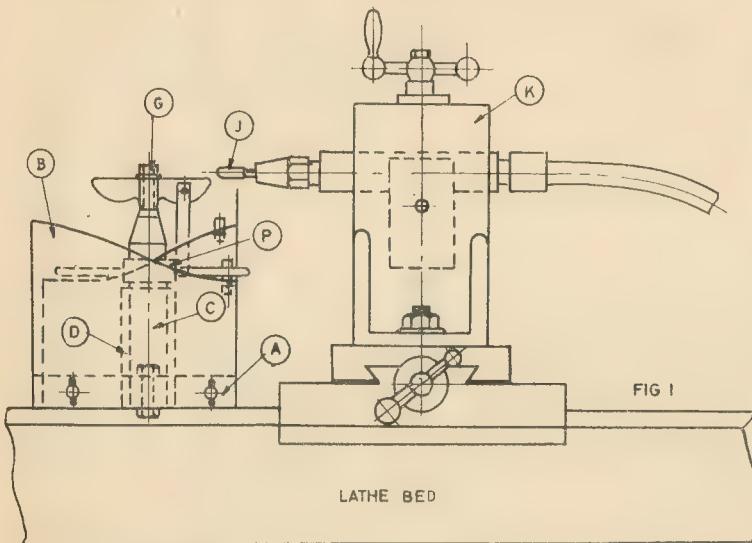
propellers

Boat performance depends a lot on accurate propellers. S. H. CLIFFORD tells you how to achieve impeccable pitch and angle

THE AVERAGE propeller fitted to model boats, whether built for speed or otherwise, is a pretty poor affair. It is either a casting which has been cleaned up, in the hope that the pattern-maker has got the pitch correct and the blades central, or it is a drilled boss slotted with a hacksaw blade into which pieces of

twisted steel have been brazed. When a pair of these is fitted to a twin-screw boat it is no wonder that it won't run straight.

The following method will produce a near perfect propeller, each blade the correct pitch with the roots right on the centre line. Having decided on the pitch and diameter to be used, the first thing required will be two thin sheet-metal angle-gauges as shown in



Above and below: Details of the slotting, milling and grinding jig

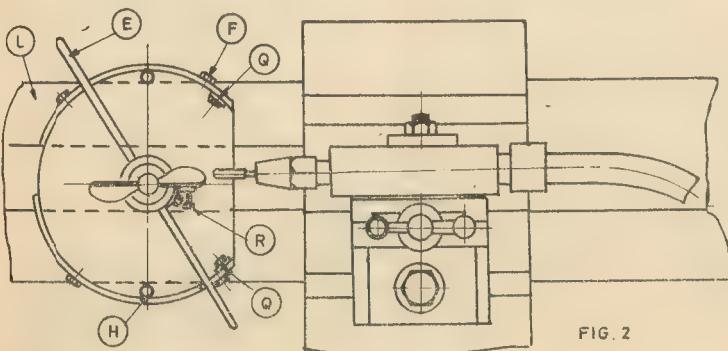


FIG. 2

Fig. 4—one for the angle of the blade at boss diameter and the other for the tip angle.

A piece of cast-steel ground stock about 6 in. long \times 1 in. wide and $3/32$ in. thick is gripped at one end in a vice and a piece of 1 in. bore tubing is slipped over, leaving about $\frac{1}{2}$ in. protruding at the upper end, as shown in Fig. 3. The tube is to prevent the strip's bending longitudinally in the next operation.

This consists of attaching a split-type tap wrench on the upper end and twisting the strip to approximately the correct angle. This can be checked by applying the boss and tip angle-gauges in the correct positions according to the length of the finished blades, as shown in Fig. 3. Incidentally, it is better to overbend at this stage as it is easier to unbend when the blades are brazed into the boss.

The slotting, milling and grinding jig (Figs 1 and 2) will be required next. It consists of a baseplate in mild steel or cast iron, as at *A*. For a $3\frac{1}{2}$ in. centre lathe the diameter should be about 6 in. or enough to accommodate the holding-down bolts, *H*, which grip the outer edges of the lathe bed.

The hole to receive the 1 in. bore bush, *D*, should next be bored and the bush should be a tight push fit. The cam plates, *B*, are made from $\frac{1}{8}$ in. mild steel, the contour at the top representing the pitch of the propeller under construction. The angle is obtained as shown in Fig. 6. The plates are then bent to fit the periphery of the baseplate and secured by setscrews, *F*.

Avoiding chatter

The spigot, *C*, is of mild steel and must be a good sliding fit in bush, *D*, otherwise chatter will result when milling the blades. The collar, *P*, is a press fit on *C*; or it can be turned solid with same. Its purpose is to provide more metal at this point as the spigot has to be drilled and reamed $\frac{3}{8}$ in. dia. to take the handle, *E*. This $\frac{3}{8}$ in. dia. hole must be dead central and at right-angles to the spigot, *C*.

In assembling cam plates, *B*, the spigot, *C*, with handle in position, should be inserted in its bush and the first plate brought into position so that it just touches the underside of the handle at near its lowest point. Secure with setscrews, *F*, making sure the bottom of the plate is level with the bottom of the baseplate. Repeat with plate No 2. Finally adjust plates by slotted holes so that the underside of the handles touches both plates in any position.

The boss is turned and drilled, placed on the spigot (Fig. 1) and locked in position by nut, *G*. The

3/32 in. dia. end-milling cutter, *J*, is fed into the boss on the centre line, as shown in Fig. 5, and the handles, *E*, are moved anti-clockwise and then clockwise to finish the cut.

The operation is repeated for the other slot by lifting the whole spigot out of the bush and turning it through 180 deg. Needless to say, the slots should be as deep as the boss will allow without breaking through to the centre hole. When the twisted blades have been brazed into the boss the propeller should be secured as shown in Fig. 1.

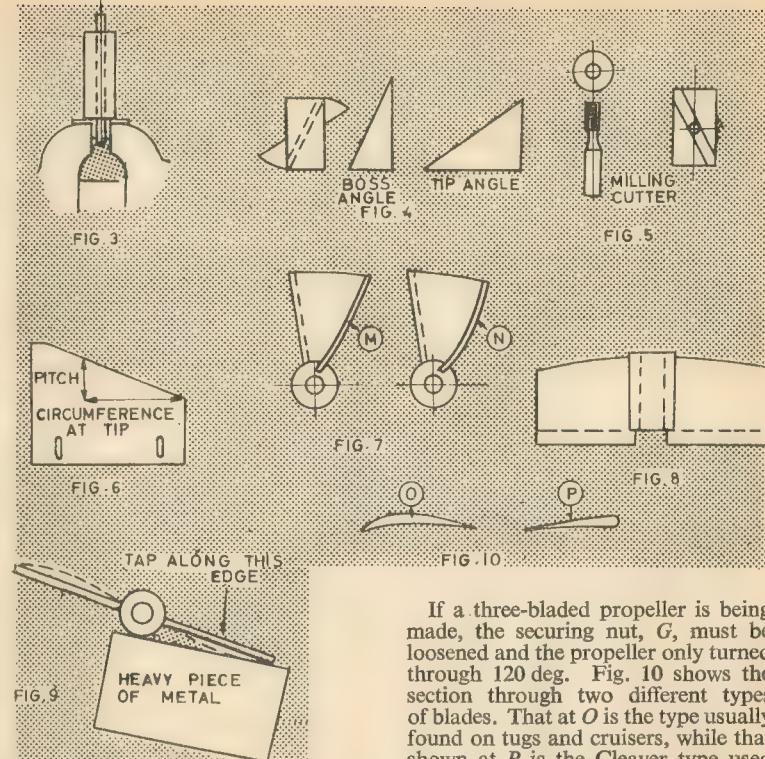
Pitch angles can be checked at various diameters by turning the handle to and fro while the point of the scribing block is held just touching the driving face of the propeller. It will be found that the leading edge, *M*, will have to be tapped slightly hollow as shown at *N* (Fig. 7).

If the blades are fixed to the boss, as shown at Fig. 8, the trailing edges below the dotted line can be gripped in the vice and the hollowing process carried out, as shown in Fig. 9.

If the blades are checked once or twice in the grinding jig for angles it will soon be apparent where the tapping is required. The final grinding operation is carried out with a $\frac{5}{16}$ in. dia. grinding wheel, having a $\frac{1}{8}$ in. radius formed on the end, as shown in Fig. 1.

A light trial cut along the top edge will show if the propeller is in the right position. Having fixed this the grinding wheel is withdrawn to the blade tip, the lathe self-act put into operation and the handles rotated backwards and forwards until the boss is reached.

The spigot is lifted out of the bush and turned through 180 deg. and the



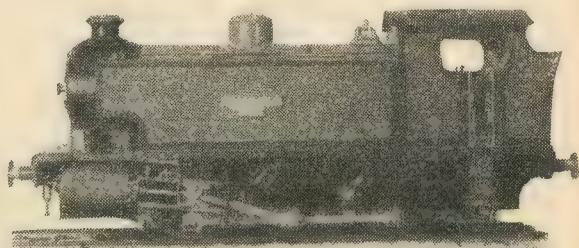
second blade treated in a like manner. The stops, *Q*, are to limit the travel of the handle and prevent the grinding wheel from running into the spigot. The right-angle bracket, *R*, is attached to the collar, *P*, and has a 2 B.A. adjusting screw and nut at its upper end. The screw is adjusted to touch the back face of the blade to take cutting strain and prevent chatter.

If a three-bladed propeller is being made, the securing nut, *G*, must be loosened and the propeller only turned through 120 deg. Fig. 10 shows the section through two different types of blades. That at *O* is the type usually found on tugs and cruisers, while that shown at *P* is the Cleaver type used on speed boats. With the latter, the back face of the blade can also be ground on the jig, the only alteration being that the cam plates, *B*, will have to be canted to accommodate the new pitch angle; or a new set of plates can be made if necessary.

This method of producing propellers has proved very successful and some excellent examples have been made by the writer.

Model locomotives

T. S. FARROW graduated from O-gauge electrics to this 1 in. scale works locomotive



THIS is a 1 in. scale model of one of Samuel Fox's works engines, the builders being R. and W. Hawthorne Leslie and Co., Newcastle upon Tyne. The cylinders are $1\frac{1}{2}$ in. bore \times 2 in. stroke and the locomotive is fitted with Stephenson's link motion valve gear. (Boiler and valve gear are built to L.B.S.C.'s words and music.)

The model was on view at a recent hobbies' exhibition, and drew quite a number of young and old "boys." I was somewhat rewarded with their appreciation for the four years' work which has gone into its building.

I started my hobby years ago with O gauge electric working models, both passenger and goods. I followed

those with a $\frac{1}{2}$ in. scale 4-6-0 L.N.E.R. Antelope class, and so on to this, my last model, named *Peter* after the son of one of the directors of the company.

The colouring of *Peter* is light and dark green with black lines. It has come up very well, and the engine is a pleasing sight as well as being a good worker.

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

CLOCK PENDULUMS

SIR.—I had no idea what I was starting when I wrote [Postbag, February 21] and offered Nilo 36 pendulum rods of which I had four surplus. I had 25 requests, so there are 21 unfortunate clock builders.

If at least five of these people are sufficiently public spirited I will furnish them with the names and addresses of four or five others whom they could contact and then do as I did: obtain a £2 length of rod from the makers (who will, of course, supply as many more rods than five as are required by each group).

The $\frac{1}{16}$ in. dia. rod is specially drawn and I had to wait 10 weeks for delivery. Also, a stamped addressed envelope for a reply would be appreciated.

A rod can go per passenger train at a cost of approximately 1s. 8d. if the weight is not over 3 lb. packed. Swinton, E. YOUNGHUSBAND, Lancs.

SLUGGED RELAYS

SIR.—R. A. J. Howard [Postbag, February 28] disagrees with my observations on slugged relays on the basis of information in a general electrical reference book. I have access to the 5th edition only of the work concerned, but I expect the relevant paragraph will not differ from that in the 6th edition.

Mr Howard is repeating a popular error, and what he writes does not quite correspond in substance to his reference.

The true facts of the case are these: (a) a relay with a slug anywhere in the magnetic circuit will be slow to release; (b) if the slug is at the armature end, the relay will also be slow to operate; (c) if the slug is at the heel end—end away from armature—the operating time will be but little affected, though the relay will be slow to release.

The explanation of this, though too long to include here, is quite simple, but if Mr Howard or anyone else should be interested I will be quite willing to set it down and send it in.

Regarding contacts, those on a standard type of telephone relay are little silver domes about $\frac{1}{16}$ in. dia. at the base. They make little more than point contact, and at 10 amp, I am quite sure they would weld solid.

These relays are indeed used up to about 1 amp but even at that current platinum contacts are needed as is also a properly designed spark-quench circuit.

Good sections on relays are to be found in the following: *Telephony*, Herbert and Proctor, Vol II; *Telephony*, Atkinson, Vol. I; *Telephony*, Poole, 8th edition; and the P.O. Engineering Dept Educational Pamphlet *Technical Electricity*, 1s. 1d.

The last mentioned may be difficult to obtain, but it is very good indeed.

May I, in conclusion, endorse H. J. Day's comments on "Locomotives I have known" [Postbag February 28] and ask that, at least for some of the engines, details of footplate and backhead fittings be included. Glasgow, E.1. JAMES J. BROWN.

"LOCH ARD"

SIR.—In response to Mr F. J. Roche's request [Postbag, January 3] the *Loch Ard* was wrecked off the south coast of Victoria not far from Port Campbell but this would be nearly 1,000 miles from Sydney.

I have visited the *Loch Ard* cemetery, which is just a very small cemetery within sound of the sea,

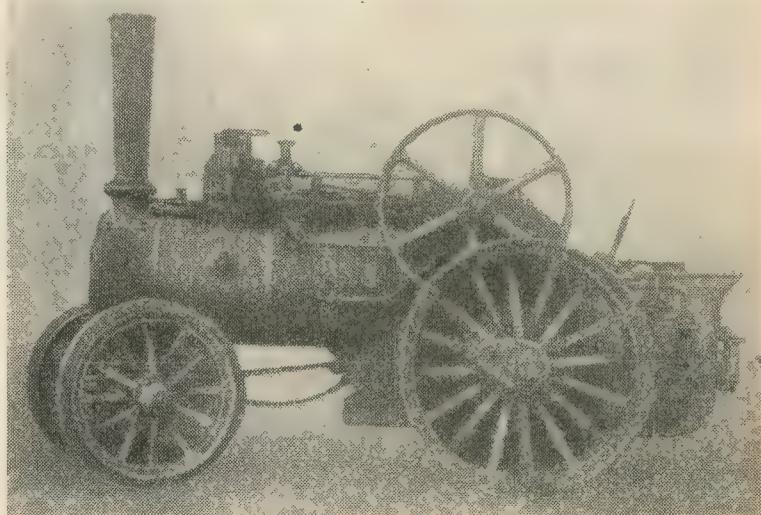
and as its name implies was created to be the resting place of those whose bodies were recovered. This wreck occurred 78 years ago and there were very few people in that locality at that time; there are not many now. Victoria, V. J. O. TOOLE. Australia.

L.B.S.C.'S NEXT

SIR.—As L.B.S.C.'s series on *Virginia* is drawing to an end how about the Festiniog railway's saddle-tank *Prince* as the prototype for the next in $3\frac{1}{2}$ in. and possibly 5 in. gauge? Harleston, JOHN BENNET. Norfolk.

● J. N. Maskelyne writes: Our correspondent is asking for rather more than he seems to realise. The gauge of the Festiniog Railway is 1 ft $11\frac{1}{2}$ in.; for model purposes, this could be taken as 2 ft, which means that a $3\frac{1}{2}$ in. gauge reproduction would have to be at least $1\frac{1}{2}$ in. scale, and for 5 in. gauge it would be $2\frac{1}{2}$ in. scale. Even after allowing for the smallness of PRINCE there are very few amateur workshops that could tackle engines in those scales, and few pockets that could bear the cost.

Traction engine photographed at Polegate by Mr Fellows a few years ago. It has W. Alchin, Globe Works, Northampton inscribed on the wheel bosses



IS OUR FACE RED ?

SIR.—Perhaps W. H. Wheeler [Postbag, February 21] would like to start a Society for the Abolition of Two-penny-Halfpenny Stamps and an Association for the Painting Blue of Pillar Boxes. Better still an Institution for the Propagation of Blue Tomatoes. Cambridge.

ERIC WINTER.

MIDLAND MODEL

SIR.—I have here the information which Mr Wilkins requires to complete his Midlands model [MODEL ENGINEER, January 17, page 92].

It is an illustration of the engraving in *The Locomotive Engine and its Development*, Stretton, Crosby Lockwood 1892, which has further information on the subject. Mr Wilkins should try to find a copy (try Heffer's of Cambridge, and Foyles and also Graftons of London).

Mill Hill, N.W.7. H. H. NICHOLLS.

CLASS F LOCOMOTIVES

SIR.—I must thank K. N. Harris for his letter [Postbag, March 7]. What an eagle eye he has !

My drawing, which dates from November 1927, has all wheels correctly spaced; it was made with the aid of reproductions of the official drawings of engine and tender, published in *Engineering*, 2 May, 1890. They are remarkable for the number of dimensions omitted, and it is in the computation of the divisions of wheelbase that I seem to have gone wrong; I was never a mathematical genius.

I have turned up the *Engineering* drawings again, and find that the distance from the bogie-pin centre to the driving-axle centre is given as 10 ft 0 $\frac{1}{2}$ in. With this as a basis, the total wheelbase is equal to 2 ft 7 in. plus 10 ft 0 $\frac{1}{2}$ in. plus 8 ft 6 in., which is 21 ft 1 $\frac{1}{2}$ in.

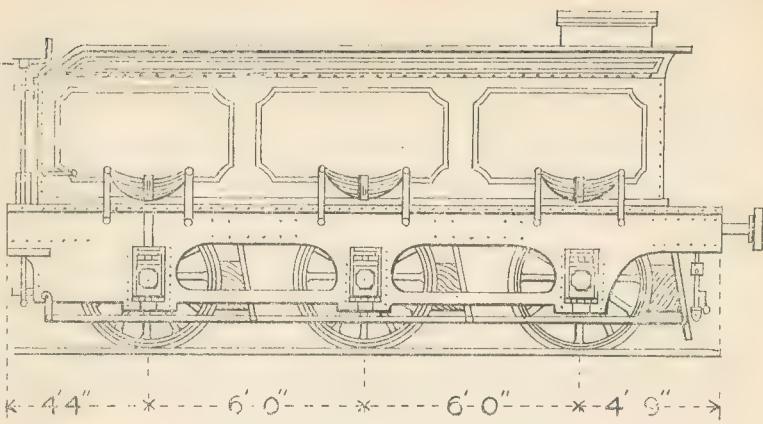
The wheelbase divisions, therefore, are: 5 ft 4 in. (bogie) plus 7 ft 3 $\frac{1}{2}$ in. (rear bogie axle to driving axle) plus 8 ft 6 in. (the distance between the coupled axles); this also adds up to a total of 21 ft 1 $\frac{1}{2}$ in.

The official drawings give the connecting-rod length as 5 ft 11 in. W.1. J. N. MASKELYNE.

No 1 LOCOMOTIVE

SIR.—I do not think the four-wheeled electric locomotive in the Science Museum is No 1.

Around 1906 the City and South London company brought out from cold storage the locomotive known as *The Prince of Wales*. If I remember it was painted in bright pea green with the Prince of Wales' feathers on the tanks, which, of course, were not tanks at all.



Side elevation of the Midland tender

The engine had been fitted with a tramway controller, something that none of the other had, and the cab floor was flat, which indicates that it had been fitted with the later type motors; the older ones had the field magnets projecting through the cab floor.

I always understood that this particular engine was No 1. It was used on the royal train when King Edward VII, then Prince of Wales, opened the line. Why this engine was brought out and much money spent on it at this particular time I do not know, as it was considerably lighter in weight than the later ones of which there was an ample supply.

A man named Jack Parkins was one of the shift drivers who handled this engine. He and his mate spent many hours and lots of emerycloth polishing the rough buffers and coupling pins.

Lightwater, H. G. SPALDING.
Surrey.

IT'S A BANGER !

SIR.—Apropos Vulcan's remarks on producing fuel from water (Smoke Rings, February 21), he might care to be reminded of water gas which is produced by passing steam over red-hot coke.

Provided the temperature of the coke is kept high (about 1,000 deg. C.), a gas of average volume composition (hydrogen 49 per cent., carbon monoxide 44 per cent., carbon dioxide 3 per cent. together with small quantities of methane and nitrogen) is produced, having a calorific value of 350 B.Th.U. per cu. ft.

For comparison, good coal gas has a calorific value of about 600 B.Th.U. per cu. ft. Water-gas burns with a very hot flame.

Incidentally, the mixture of hydrogen and oxygen in the proportions obtained by electrolysis of acidified

water (two to one by volume) is explosive, although the temperature of ignition is higher than with a mixture rich in oxygen. Anyone who intends to experiment with this should be warned about the violence of the explosion !

Abingdon, Berks.

J. REMDO.

BUILDING "BUTCH"

SIR.—I was very interested in W.H.C.'s query in the building of *Butch*. I have recently completed this engine, and I am delighted with its performance; the power developed took me by surprise.

It has steamed on several occasions for three hours at a stretch and the only trouble I experienced after a preliminary oil failure, which was cured by fitting a single oil pump, was that there was too much water, causing priming. Larger bypass pipes have been fitted to the axle-driven pump, but the pump will probably have to be replaced with a smaller one.

The boiler is Sifbronzed and silver soldered, there are no screws in the shell and no soft solder; even the fire door is fitted into blind bushes. The stays are plain copper rivets welded in with Cuprotectic, which method has proved satisfactory in practice.

If W.H.C. builds this locomotive, he should, in my opinion, rearrange the fittings on the backhead, in particular the blower hollow stay, and fit additional bushes to take clacks for the hand pump and injector. The handle of the hand pump should be turned out of rectangular material, when made out of round rod mine broke at the pivot.

I suggest that W.H.C. obtains L.B.S.C.'s book on *Maisie* and H. E. White's book on *Maintenance of Small Locomotives*. He ought to look up any of L.B.S.C.'s relevant notes in MODEL ENGINEER, or better still

POSTBAG . . .

Austin-Walton's notes on *Twin Sisters*. Finally, he should join a model engineering society where there is a strong locomotive section; there he will find all the help and advice he requires.

Hull, Yorks.

G. I. HELM.

WRITING IT UP

SIR.—It was with considerable interest that I read Mr Powell's letter and your footnote [Postbag, February 28] concerning the difficulties of writing about the activities of model engineers.

There must be many who would be willing to tell the story of their modelling activities, even if they were not prepared to write about them. Likewise, there must be some model engineers who are capable of recording those stories in the form of an article. I, for one, would be happy to cover an area within a reasonable distance of Chard—petrol restrictions would, of course, tend to hamper movement at present.

Now if volunteers would communicate their willingness to be the subject of articles, it would only remain for a mutually convenient date to be arranged and all these unrecorded activities would be gathered in.

Chard, Somerset. J. HANDEL.

GRINDING OF MOWER

SIR.—I was glad to read F. C. Atkinson's letter [Postbag, February 21] and I would hasten to assure him that I not only wrongly omitted mention of the essentiality of grinding the bottom plate, but also my loathing, on principle, of grinding in the lathe!

However, with me this is only perhaps an annual job, and I think even Duplex's attitude to grinding in the lathe is that it is permissible, given reasonable protective precautions.

I am interested to learn that the grinding is quite satisfactory when the cylinder is continuously rotated, provided the axis of the cylinder is above that of the grinding wheel, but this presupposes sufficient clearance between lathe centres and bed. In any case, with an ML7, this is not so, and the use of false centres and raising the height of the cylinder axis above the lathe axis are necessary, even if the cylinder is ground blade by blade.

Fawkham, Kent. K. STOCKER.

SIR.—Mr Atkinson [Postbag, February 21] cannot expect one seriously to take his statement that if the

cylinder of a mower is placed above centre of grinding wheel and that they are both revolved on their own axis, there will be ample back off. I contend that the whole depth of edge of each blade will be part of a perfect cylinder, it cannot be otherwise.

To get "back off" each blade must be acted upon separately, setting the mower axis either above or below axis of grinding wheel according to way mower cylinder is placed on its axis.

The method of grinding cylinder blades and bottom blade as suggested is very bad, as one is producing an arc in the bottom blade to that of the cylinder blade which will in use tend to cause jamming.

King's Lynn. JOHN D. ELAM.

SHADING LINES

SIR.—In his interesting articles on mechanical drawing aids Duplex describes a method of ensuring equal spacing of shading lines. I thought readers might like to hear of another method which perhaps is a little less complicated.

The 45 deg. setsquare merely needs scribed lines parallel to its edges, at a distance from the edge equal to the distance between the shading lines. I find two lines per edge quite efficient and provided the square is reasonably transparent it is very quick

and easy to line up the line first drawn with that scribed on the square. Thus the square is moved over the drawn lines instead of away from them. Inking cannot be done this way but pencilling the shading first takes very little time.

Ashtead, Surrey. A. K. POTTER.

SELF-SUFFICIENT

SIR.—Some time ago I contemplated buying a bungalow in the wilds of Dorset, and inspection failed to reveal mains of any sort. As I intended to make one room into a workshop everything would centre round this, so light, heat and power were required. Internal combustion engines were ruled out as fuel is expensive.

I thought a slow combustion Tortoise stove would take care of the heating; then I thought the same stove could also produce power and light if I put a flash steam coil inside the stove to drive a suitable engine and dynamo.

The final scheme is: the above steam generator coupled to a double Tangye driving a 1½ kW d.c. generator (which I have). If a.c. is taken from the generator it can be transformed to 230 volt for motors and fluorescent lighting.

Imagine being invited to an engineer's home with everything run by one of these lovely engines. Bath.

R. A. GARRAD.

VIRGINIA

Continued from Page 469

neath, bending the pipe to the shape shown in the drawings, and attach to the soleplate by 3/32 in. or 3/48 screws through the holes in the flange, tapping the soleplate to suit. Put a 1/64 in. Hallite or similar gasket between the flange and soleplate. Solder the small bush for the spindle into the corresponding hole in the tank top and replace the screwed cap. The spindle can be left out until the tank top is permanently attached, when it is screwed into the valve through the bush as shown.

On the opposite side, at the corresponding position in the other water leg, drill a 1/2 in. clearing hole and fit the pump strainer to the soleplate in similar manner, with the gauze finger projecting up inside the tank. Use 9 B.A. or 2/56 brass screws for attaching, with a gasket between the flange and soleplate as before. Bend the feed pipe as shown in the drawings.

The bypass fitting is attached in like manner, the hole for same being drilled approximately 1 in. ahead of the pump valve box and 1/2 in. to the right of the centre line of the tank (see plan). Attach as before and then

bend the upper section of the pipe so that the end of it comes just under the filler. This gives a visible check on the amount of water going into the boiler when the bypass valve is partly open.

The union elbow goes through a 1/2 in. hole drilled in the soleplate in line with the bypass fitting and a bare 1 in. to the left of centre line. It is secured with the locknut and connected to the pump valve box by a swan-neck of 5/32 in. pipe, with a union nut and cone at each end. As the delivery pipe from the hand-pump has to withstand boiler pressure, slip-on hoses, as used for feed and bypass connections, would be useless so a cycle-pump connector can be used.

One end has a short piece of 5/32 in. pipe with 1/2 in. × 26 union nut and cone for connecting to the union on the engine attached to it. The other end a longer pipe with 1/2 in. × 40 union nut and cone for connecting to the union on the elbow. The length of this is determined by the length of the connector. The joints may be soldered or screwed as desired.

● *To be continued.*

READERS' QUERIES

Do not forget the query coupon
on the last page of this issue

This free advice service is open to all readers. Queries must be on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope and query coupon with each query. Mark envelope "Query," Model Engineer, 19-20, Noel Street, London, W.1.

Cleaning metals

I wish to clean, by immersion, such metals as brass and copper, aluminium and zinc-base alloys. What chemicals would you suggest?—E.H.N., Wakefield, Yorks.

▲ It is usually possible to clean these metals with acids—provided that they are not left in contact with them for too long and that they are thoroughly freed from the action of the acid afterwards by several rinses with clean water.

For brass and copper, nitric acid is suitable and for aluminium a comparatively weak solution of hydrochloric acid. The same applies to zinc, the alternative being sulphuric acid. Generally speaking, a comparatively short dip in the acid is sufficient, but the articles should be mechanically cleaned by scouring and also degreased before immersion.

Drawings for 2-10-4

Can you advise me where to obtain drawings of the Canadian Pacific Railway's Selkirk type locomotive? It was an oil-burner and had a wheel arrangement of 2-10-4.—K.S., Dundee.

▲ It is unlikely that working drawings can be obtained in this country; certainly none of the English railway periodicals have ever published them. Your best course would be to communicate with the London offices of Canadian Pacific Railway, 62, Trafalgar Square, London, W.C.2.

Diesel-electric locomotive

I hope to construct a model of a typical diesel-electric locomotive suitable for use on an outdoor garden track and capable of hauling a maximum load of 300 lb. Before starting I would appreciate your advice on the following points:

Most suitable gauge and scale (approximate length of track would be 88 yards).

It is hoped to employ a Ward Leonard system of control, the prime mover being a petrol-electric M.G. set supplying power to the driving motor. As most Ward Leonard schemes appear to utilise shunt motors for the final drive, does this preclude the use of such a scheme for traction purposes? If not, can the series motor be used in its place with, of course, suitable reversing arrangements?

If Ward Leonard control is impracticable for a traction scheme such as this, what other method would you suggest?—J.W., Hinckley, Leics.

▲ At the present time the question of small diesel-electric locomotives suitable for use on outdoor garden tracks and the like is one that is subject to experiment. There is as yet very little information upon which to work, but the indications are that the losses which occur in these small units are so great that there is very little power left for haulage purposes.

You suggest employing a Ward Leonard system of control. But for such a unit to be of any practical use it would have to be about as big as a grand piano—and even on 15 in. gauge the power output would be very disappointing. Since you have only 88 yards available for the track 15 in. gauge would be much too large, even if sufficient haulage power could be obtained.

An alternative scheme would be the extremely powerful and efficient straight petrol locomotive (based on an 0-6-0 type shunting locomotive as used by the former L.M.S. Railway) designed by Edgar T. Westbury. A number of these units have been built by readers of MODEL ENGINEER and they work very well. The unit, designed for 3½ in. gauge, was found to be large enough to incorporate the special petrol engine designed for it; the unit

is known as the "1831." Drawings for the engine, which is a twin cylinder 30 c.c. water-cooled engine 1 in. bore × 1½ in. stroke, are obtainable from the Percival Marshall plans department.

Spindle removing

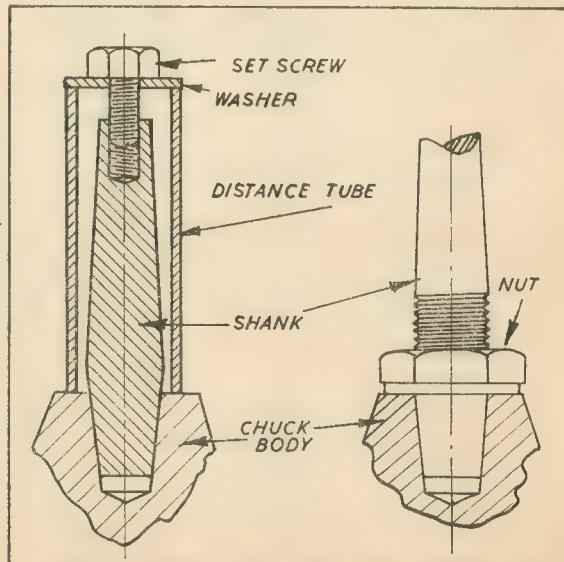
I have purchased a ½ in. bench driller, but I find the Jacob's chuck is in need of repair. I have stripped the spindle down but the chuck is firmly attached to it, and I cannot remove them.

Could you tell me how to get the chuck off?—W.C.W., Birmingham.

▲ The standard method of attaching the spindle is by a fine taper on the shank, fitting a tapered hole in the end of the chuck—though, occasionally, other methods such as screwing have been employed. The spindles are often found extremely difficult to remove, but one method which may be applicable is to drill and tap a hole in the end of the spindle, place a piece of tube over the spindle bearing against the back of the chuck and apply a set screw and washer on the top end of the tube.

Another method, operating on the same principle, can be used if there is a short plain portion near the large end of the spindle. That is to externally thread the spindle as close to the chuck as possible and screw on a nut with a washer bearing on the back of the chuck.

Two alternative methods of removing a light taper spindle from the drill chuck



★ ★ ★ CLUB NEWS ★ ★ ★

Edited by THE CLUBMAN

HOW many clubs make a practice of selecting a model and letting the members take it in turns on successive club nights to describe the separate parts one by one until the entire model has been constructed in words?

Besides providing a good deal of entertainment such part-by-part descriptions are of enormous educational value to the model engineer. They acquaint him intimately not only with a particular component but with the details of the whole construction, and they also help him to be more articulate about his own work. Some of the best model engineering is done by men who lack the gift of communicating their processes for the interest and guidance of others. They think it easy until they come to do it. To describe a complicated construction in words is in fact very difficult. Nor is the practised journalist likely to find it other than formidable when the information that he tries to interpret to the public is not made clear to himself in the first place!

Hull Society of Model Engineers is therefore to be congratulated on its decision to introduce part-by-part descriptions as an innovation in 1957. Interest on meeting nights can hardly fail to be stimulated so long as the selected models are sufficiently varied.

Their best model

I say this because the Hull society does not suffer from narrowness. After judging its competition for the best model of 1956 C. Ward praised the high quality and variety of the exhibits. They included Taylor's 3½ in. gauge *Maisie* chassis, Lee's bench pin drill and stand complete with electric motor, Young's 3½ in. gauge L.M.S. *Doris*, Lakeman's complete steam plant (horizontal engine and launch-type boiler) and Plaster's 3½ in. gauge *Doris* tender.

It was a spinning wheel by G. Wilson which won the award. Mr Wilson had constructed it beautifully of wood with the usual metal pieces. His turning was masterly.

CALLING ALL YACHTSMEN

Radio-controlled model yacht racing is becoming increasingly popular and the **London Group** of the International Radio Controlled Models Society is very much alert to its prospects. With the introduction of tactics and smart handling—apart from sheer speed—

many owners of full-size yachts may, it is thought, become interested in model yacht racing.

The group expects a lively profitable meeting on April 14. It will be one that everyone concerned with radio-controlled yachts would like to attend, and chairman T. C. Carrington-Wood (7, Queensborough Studios, London, W.2) sends, through this page, an invitation to all. At the meeting a racing yachtsman will lecture on yacht racing with particular reference to radio-controlled models; examples of equipment will be exhibited, and a discussion will follow.

Meetings are held every month (visitors are always welcome) at the Kingsley Hotel, Bloomsbury Way, W.C.1, at 2 p.m. One on March 10 was devoted to a lecture and demonstration of crystal-controlled superhet radio-control equipment—a subject which many MODEL ENGINEER readers outside the I.R.C.M.S. would have found fascinating.

THIS YEAR'S REGATTA

Here is the fixture list so far compiled by the M.P.B.A.: May 19, South London; May 26, Forest Gate; June 2, Bedford; June 8, Welling; June 10, Bournville; June 16, Coventry; June 23, Victoria; June 30, Mortlake Radio-Control and Bristol; July 7, Wicksteed (provisional); July 14, Bromley; July 21, M.P.B.A. Radio-Control (Taplin Trophy included); July 28, Southend; August 4-6, St Albans M.P.B.A. international (Speed); August 11, South London Radio-Control; August 18, Southampton; September 1, Grand Regatta; September 8, Altrincham; September 15, Blackheath; September 22, Kingsmere; and September 29, Portsmouth (at Southampton).

Clubs wishing to hold an inter-club regatta are asked to send in their dates as soon as possible so that the full fixture list with times and places can be prepared.

Details of the British Model Yacht Association open championships for 1957 are as follows:

Class	Date	Venue
36 in.	April 20-22	Bournville
M	June 8-10	Birmingham
6 in.	June 15-16	Glasgow
10R	July 1-6	Gosport
A	Aug. 18-25	Fleetwood

The M.Y.A. racing secretary is M. Fairbrother of 52, Alderbrook Road, Solihull, Warwickshire.

M.E. DIARY

March 28.—South London S.M.S. "Brixham Trawlers," W. O. B. Major.

March 29.—Northern Models Exhibition, Corn Exchange, Manchester (March 29-31). World Ship Society, Merseyside branch, "Sixty Years of the Mersey Ferries," W. B. Hallam, Incorporated Accountants' Hall, Fenwick Street, Liverpool, 7.30 p.m. North London S.M.E. locomotive section at H.Q. 8 p.m. J.I.E. "Making Use of Russian and Czech Scientific and Technical Information," E. Gros, Pepys House, 7 p.m. I.M.E. Lubrication Group "Rotary Shaft Seals," E. T. Jagger, 6 p.m.

March 30.—S.M.E.E. Rummage Sale, Wanless Road, 2.30 p.m.

April 3.—North London S.M.E. miniature railways, H.Q. 8 p.m.

April 4.—Chingford and District M.E.C. exhibition, Conway Hall, High Street, Walthamstow (April 4, 2.30 p.m.-9.30; April 5, 5 p.m.-9.30; April 6, 12-9 p.m.). Eltham and District L.S. annual meeting, Beehive, 8 p.m.

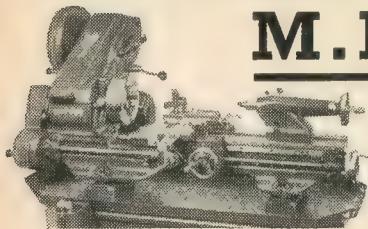
April 5.—Port Talbot, Neath and District S.M.E. work night on track. North London S.M.E. "Bits and Pieces" Night, Eastern Region Gas Offices, Station Road, New Barnet, 8 p.m. I.M.E. "Modern Trends in Waterworks Pumping Machinery," T. Irvine Hudson, 6 p.m.

April 8.—Clyde Shiplovers' and Model Makers' Society annual meeting, Kelvingrove Museum, Glasgow, 7.30 p.m.

April 9.—Electrical Engineers Exhibition, Earls Court, London (April 9-13; 10 a.m.).

★LAST CHANCE TO ENTER FOR THE

M.E. COMPETITION



CONDITIONS OF ENTRY

1. The judges shall decide the order of priority and decide the award of the prize.
2. All coupons will be scrutinised and no claim is necessary. Proof of posting will not be accepted as proof of delivery and no responsibility can be accepted for entries lost, delayed, or damaged, before or after delivery.
3. Closing date for the competition is first post on Friday, 5 April 1957.
4. Employees and the relatives of employees of Percival Marshall & Co. Ltd, and associated companies are not eligible.
5. Any question arising out of, or in connection with, the competition will be decided by the judges and their decision must be accepted as final and conclusive. No correspondence can be entered into.
6. Mutilated or altered entry forms will be disqualified.

- A. **Model locomotives.**—Their construction, maintenance and running. Descriptions of models which have been built.
- B. **Railways and locomotives.**—Features on modern locomotives and railway practice in different parts of the world.
- C. **Railways, historical and unique.**—Articles on great locomotives of the past and of lines, systems and practices no longer or little used.
- D. **Model traction engines.**—Constructional series and articles on models which have been built or exhibited.
- E. **Traction engines, prototype.**—Articles on types of machines which are or have been in use; reports of rallies and traction engine events.
- F. **Model steam-engines.**—Articles describing how to build model steam-engines. Descriptions of how they have been built.
- G. **Model power boats.**—Reports of regattas up and down the country and abroad. Operational hints. Descriptions of outstanding craft.
- H. **Workshop practice.**—Advice on difficult procedure in home workshops. Constructional features on how to build accessories and tools.
- J. **Model ships, historical.**—How to build such models as *Myrmidon*; also descriptions of models in museums and exhibitions.
- K. **Model ships, modern and power.**—How to construct models of liners, tugs, etc., and the power plant by which they are driven.
- L. **Working model yachts and full-rigged sailing ships.** Construction and operation. Regattas.
- M. **Clocks.**—How to build clocks and accessories for them. Repairs, etc.
- N. **Internal combustion engines.**—Constructional features of model i.c. engines which can be put to practical use. Descriptions of some of the well known classes and types.
- P. **Photography.**—Articles on making photographic accessories, projectors, optical and scientific instruments, including microscopes. Also hints on photography.
- Q. **Steam-engines.**—Articles on prototype beam engines, mill engines and horizontal engines.

BE the Editor of MODEL ENGINEER for a day! That is the invitation which is extended to all readers with a competition in which their judgement as Editor will be put to the test. The prize in this simple but intriguing competition is a **MYFORD SUPER SEVEN LATHE**

Listed below are the headings of the principal contents of MODEL ENGINEER. Put them in what you consider is the order of interest and importance to readers by placing the letter against each section in the appropriate column on the coupon. For example, if you think the articles in category E come first, place an E against 1st in number one column and so on.

A panel of judges, balanced in their interests, will be set up by the Editor of MODEL ENGINEER and the entrant who submits the coupon which is nearest to the judges' verdict will be awarded the prize. The closing date will be Friday, 5 April 1957. Entry is free and any number of entries may be submitted, but each must be on the printed coupon which must be fully completed

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Lathe Attachment and castings, drill grinding jigs. List 6d.—G. P. Potts, Yew Grove, Troutbeck, Windermere.

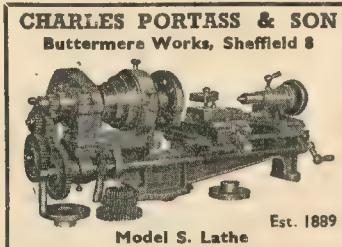
Zyto 3" Lathe on stand. Two 4" chucks, countershaft, collets, list, £30. Accept £35. View after 7 p.m.—PACKER, 20, Waldemar Road, Wimbledon.

3" High Speed sensitive power bench drilling machine, £6 10s. S.A.E. details. Credit terms available.—WANSTEAD SUPPLY Co., 30, The Broadway, Woodford Green, Essex.

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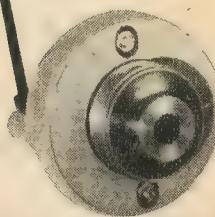
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Emco Unimat Miniature universal machine tool, with all auxiliary equipment, factory new, for sale, price £52. Apply—BERNFIELD, 282, Kingsland Road, London, E.8.

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Capstan Lathes, spindle end to capstan face 7 $\frac{1}{2}$ ", spindle to bed top 3". Bar capacity $\frac{1}{2}$ ", swing over bed 6". Without motor drives. These are new but slightly damaged in storage, surplus to Government contract, £18 each. Metal cabinets for above, £8 each. Cast iron mounting trays, £2 each, plus carriage.—R. SOUTHERN & CO. LTD., Wakefield Road, Brighouse, Yorks.

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3 $\frac{1}{2}$ " Coal-fired Tank locomotive and passenger truck for sale, £55.—Box No. 8470, MODEL ENGINEER Offices.

Pressure Gauges, 60 lb. per sq. in., 1 $\frac{1}{2}$ " dia., 2s. 6d. each, post 6d. Taylor 65B signal generator, £3. R1132A (modified) £2 10s. Buyers collect.—DUNDERDALE, 32, King's Drive, Heaton Moor, Stockport.

Wanted. "O" Gauge clockwork locomotives and tin-plate coaches. Lowke, Bing or Marklin. In pre-group colours for preference. Write giving details to—21, Craddocks Avenue, Ashtead, Surrey.

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Locos for Sale. 6" gauge 0-8-0, 0-6-0, 3 $\frac{1}{2}$ " gauge Atlantic, two passenger trucks. Offers for all or separate.—HOLLAND, 149, Kings Avenue, Greenford, Middx.

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Wanted. Any Parts or castings for $\frac{1}{2}$ " scale "Princess Royal"—COX, 73, Warwick Way, Victoria, S.W.1.

New Zealand Readers. Wanted 5" gauge locomotive "Butch" or similar, in working order. Would also consider one partly completed.—ROBINSON, Scotland Street, Picton, N.Z.

Sale. 10 $\frac{1}{2}$ " Gauge "Royal Scot" completely rebuilt. For further particulars apply—COLONEL TYRELL, Stepaside, New Romney, Kent. What offers?

Wanted. Old Model Locomotives, trains, trams, steam fire engines, automobiles, and model catalogues. Will send new trains or American dollars.—WALTER POPEK, 15, Main Street, Garfield, New Jersey, U.S.A.

"Butch" Chassis, cylinders machined, all boiler material, drawings, first class workmanship, £16. S.A.E. for details.—APPLEWHITE, 97, Field Lane, Burton-on-Trent.

210' Vignoles Extruded brass rail, suitable 2 $\frac{1}{2}$ "-3 $\frac{1}{2}$ " gauge, 1s. 3d. ft.—HUTT, Madison Villa, Fraddon, Cornwall.

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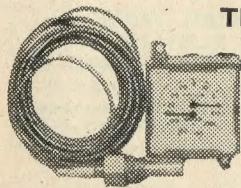
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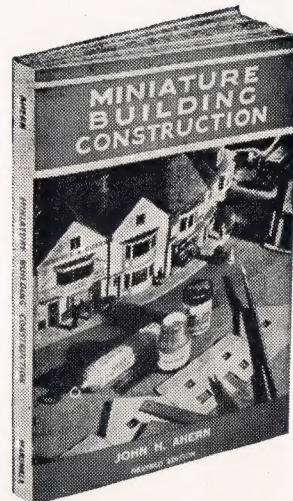
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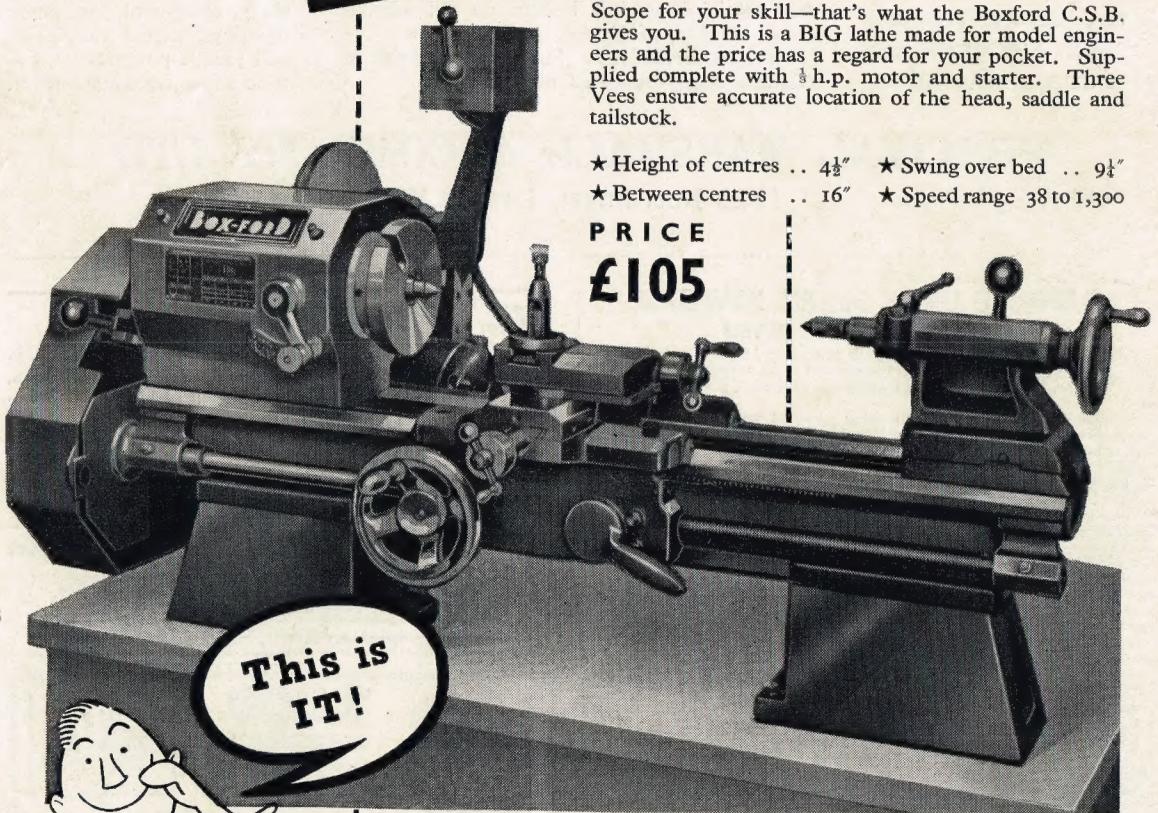
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